OPERATING AND MAINTENENCE MANUAL

PORTABLE SPECTRUM ANALYZER

VSM-5B

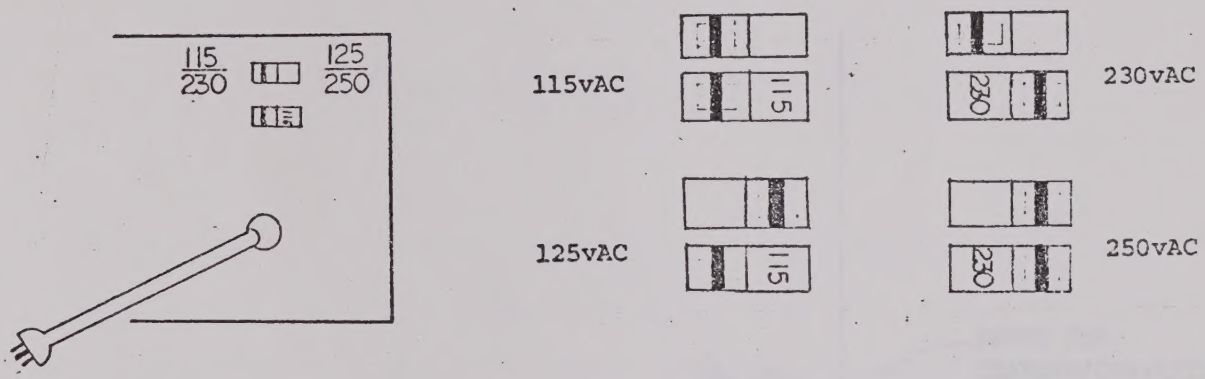
P/N 001-105

MP MASTER
MA33252

Texscan
INSTRUMENTS

CAUTION

Check the charger/converter for proper input power source settings. Refer to Figure 1 below.



NOTE: Line fuse (s) must be checked for the proper rating and type. 1/2 amp for 230V/250V and 1 amp for 115V/125V operation.

WARNING: Damage to any unit which is connected to the improper power source constitutes "misuse", and is not covered by the Texscan Warranty.

WARNING: Case temperature of the VSM-5B charger/converter can exceed 60° C under normal operation.

CAUTION

The BATTERY SAVER circuit in the VSM-5B works such that if the battery is discharged below 10 volts the VSM-5B will not respond when engaging the power switch. If the VSM-5B will not respond, check to see if the battery has been discharged, before contacting Texscan Customer Service.

CAUTION

Removing AUXILIARY INPUT plug will disengage the internal vertical and horizontal drive circuits. Check to insure plug is properly engaged if vertical and horizontal trace does not appear at turn on. Tune INTENSITY down as bright spot may burn CRT phosphor.

WARNING

DO NOT CONNECT INPUT POWER SOCKET OF THE VSM-5B TO ANY A.C. INPUT POWER SOURCE.

See Figure 2.

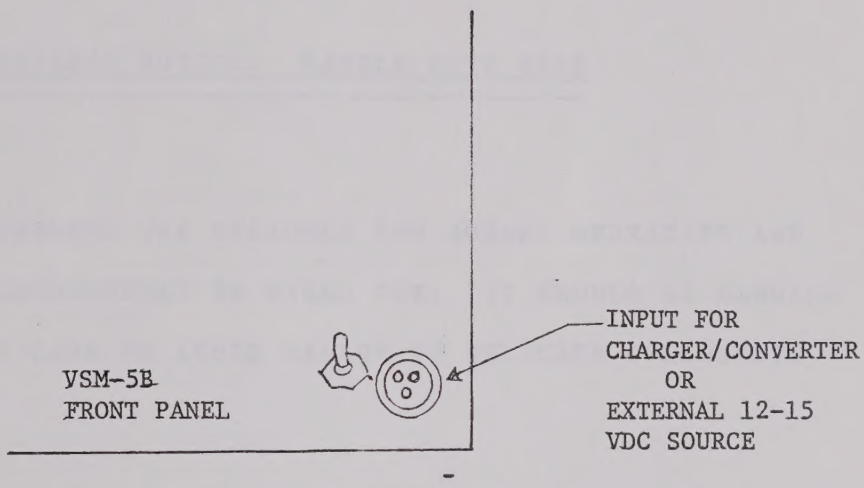


FIGURE 2

IMPORTANCE NOTICE: HANDLE WITH CARE

THIS ELECTRONIC INSTRUMENT WAS DESIGNED FOR NORMAL OPERATING AND STORAGE CONDITIONS ENCOUNTERED IN FIELD USE. IT SHOULD BE HANDLED AND TRANSPORTED WITH CARE TO AVOID DAMAGE TO DELICATE COMPONENTS AND CIRCUITS.

PERSONNEL UNFAMILIAR WITH ELECTRONIC INSTRUMENTS SHOULD BE INSTRUCTED TO AVOID DROPPING, THROWING, BOUNCING, STRIKING, OR OTHERWISE MIS-HANDLING THE UNIT. WHEN TRANSPORTING THE UNIT IN A VEHICLE, CARE SHOULD BE TAKEN TO CUSHION IT AGAINST SEVERE SHOCKS THAT MIGHT OCCUR.

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SECTION 1

SPECIFICATIONS

1.1 INTRODUCTION

The VSM-5B Spectrum Analyzer is a general purpose, high reliability instrument designed for making rapid signal strength measurements in the 4 to 450 MHz frequency range. The unit is completely portable and can operate off its own internal rechargeable batteries or from an external 12 to 15 volt source, including vehicle 12V battery with a negative ground. It is provided with a protective case and a carrying handle for simple field operation in adverse environments, and weights less than 30 lbs.

The VSM-5B displays a 60 dB dynamic range for signal levels as low as +10 dBmV, relative amplitude measurements can be made in seconds. A manual sweep mode is included for amplitude measurements where integration of the modulation is necessary for more accurate readings of signal strength. Measurements within ±2 dB can be made simply, swiftly and reliably. The internal battery is capable of three hours of continuous operation. With care 12 hours intermittent operation between recharges can be easily achieved.

Frequency can be easily identified within ±100 KHz using the center frequency slide rule dial combined with the frequency markers. Amplitude measurements can be made over a 122 dB range utilizing the input attenuation and 60 dB on-screen amplitude calibration.

1.2 FREQUENCY SPECIFICATIONS

Frequency Range:	4 to 450 MHz, .4-4 MHz with reduced specifications Band B: 4 to 450 MHz, front panel Band C: adjustable down to 5 MHz Band D: sweep width minimum.
Calibrated Dispersion:	3, 15 and 200 KHz/div. and 1, 10 and 45 MHz div., ±20%, continuously variable, and CW
Frequency Accuracy:	dial accuracy is ±5 MHz. Typical accuracy is ±2 MHz from 50° to 90° F
Stability (Drift):	typical drift of unit (after 10 min. warmup) is 30 KHz/min. and 200 KHz/10 min. when not phased locked. After 1 hour warmup and unit is phased locked, drift is 10 KHz/min., and 100 KHz/10 min.
Residual FM:	less than 10 kHz peak-to-peak (not phase locked) less than 200 Hz peak-to-peak (phase locked)

NOTE: Sensitivity, frequency response, and amplitude display measurements must be made at resolutions and rate time dispersion products that do not degrade the response time displayed on the CRT. Therefore, when making such measurements the operator should set the RATE, RESOLUTION, and DISPERSION controls such that the signal level displayed has been maximized.

NOISE SIDEBANDS:	more than 68 dB below CW signal level. 15 KHz or more away from signal.
INPUT IMPEDANCE:	75 ohms, return loss greater than 18 dB for input attenuator settings of 10 dB or more.
FREQUENCY MARKERS:	1, 10, and 50 MHz.
MARKER ACCURACY:	±0.01%
RESOLUTION:	IF bandwidths 200 KHz, 10 KHz & .5 KHz @ 3 dB points, 60 dB/3 dB ratio (200 KHz & .5 KHz = 20/1, 10 KHz = 4/1).

1.3 AMPLITUDE SPECIFICATIONS

Measurements Range:	-50 dBmV to +72 dBmV @ 200 KHz resolution.
Average Noise Level:	-52 dBmV @ 200 KHz bandwidth.
Frequency Response:	with the input attenuator set at 10 dB, the frequency response, including the input attenuator, is ±1 dB from 10 to 350 MHz and ±1.25 dB from 10 to 450 MHz.
Amplitude Display:	relative amplitude accuracy for 60 dB range ±2.0 dB (not including frequency response error).
Graticule Marking:	60 dB log scale calibrated in dBmV (-50 dBmV to +10 dBmV). 30 dB scale calibrated in dBmV (-50 dBmV to -20 dBmV).
Residual Responses:	less than -50 dBmV with no signal input. (4-450 MHz)
Attenuation:	RF attenuation is 62 dB maximum in the following steps: 1, 2, 3, 6, 10, 20 and 20 dB.
Gain Compression:	+25 dBmV input, 6 dB RF input attenuation creates 1 dB of compression.
Hum Measurements:	calibrated at 2% per major division input level for HUM. Measurement must be between -10 to +10 dBmV.
Video Filter:	post detection filter used to average the noise. Switch selected 1 KHz and 10 Hz bandwidth.

CAL OUT:	54 MHz (.005%) @ +10 dBmV. 54 MHz output level accuracy ±.25 dB @ 70° F and ±.75 dB over operating temperature range.

1.4 DISPLAY SECTION

Cathode Ray Tube:	3750 volt potential, P7 phosphor,
Graticule:	8 x 10 division (approximately 2" x 4" or 5 x 10 cm), subdivisions per major division on horizontal and vertical axis.

1.5 GENERAL CHARACTERISTICS

Intermodulation Distortion:	for two ±10 dBmV signals the third order is down 60 dB or more. The second order of two +10 dBmV signals is down by 50 dB. The second order of a single +10 dBmV signal is down by 55 dB or more.
Sweep Rate:	rate is continuously variable from .03 to 30 Hz and manual.
Temperature Range:	operating +20° F to +100° F, (-7° C to +38° C). Storage -30° F to +140° F (-34° C to +60° C).
Power:	internal batteries, external +12 to +15 volts DC @ 1.5 amps. Approximately 3 hours of continuous operation on internal batteries.
Dimensions:	8" x 10" x 10.5" (20.3 x 33 x 26.7 cm).
Weight:	approximately 27 lbs including battery (battery weight is 6 lbs) (2.3 kg). Shipping weight is approximately 35 lbs (11.4 kg).
Video Out:	+10 dBmV input level produces +1 volt output.

SECTION 2

BLOCK DIAGRAM AND CIRCUIT DESCRIPTION

2.1 INTRODUCTION

The following paragraphs describe circuit functions depicted in the block diagram, Figure 4.

2.2 ATTENUATOR

The RF attenuator attenuates input signals in 1, 2, 3, 6, 10, 20, and 20 dB steps.

CAUTION: The input to the attenuator must not exceed 1 watt average and the output of the attenuator must not exceed 1 milliwatt average.

2.3 FIRST LOCAL OSCILLATOR

The voltage tuned oscillator can be set for either a swept or CW output in the 650 to 1100 MHz range.

2.4 FIRST MIXER

The first mixer is of the double balanced type, using four matched Schottky barrier diodes configured as a ring modulator. The input and output circuits are connected through special wideband transformers designed for this purpose. The output of the first mixer is 650 MHz couples to the input of the 650 MHz amplifier.

2.5 650 MHz BANDPASS FILTER

The bandpass filter selects the 650 MHz frequency component in the amplifier output.

2.6 SECOND LOCAL OSCILLATOR

The second local oscillator is a stable tuned-line oscillator operating at a center frequency of 586 MHz. The output of the second local oscillator is couples to the second mixer. In narrow dispersion modes the second local oscillator is swept by an amplified ramp derived from the rate generator. This ramp signal varies the capacitance of the second local oscillator transistor.

2.6 SECOND MIXER

The output of the second local oscillator and the filtered output of the first mixer are heterodyned in the second mixer to produce an output of 64 MHz. The output of the second mixer is filtered to remove unwanted responses, and the 64 MHz output is coupled to the second IF amplifier. This amplifier is a transistor circuit with a low noise figure. The 64 MHz bandpass filter has a high insertion loss because of its selectivity and therefore follows the amplifier.

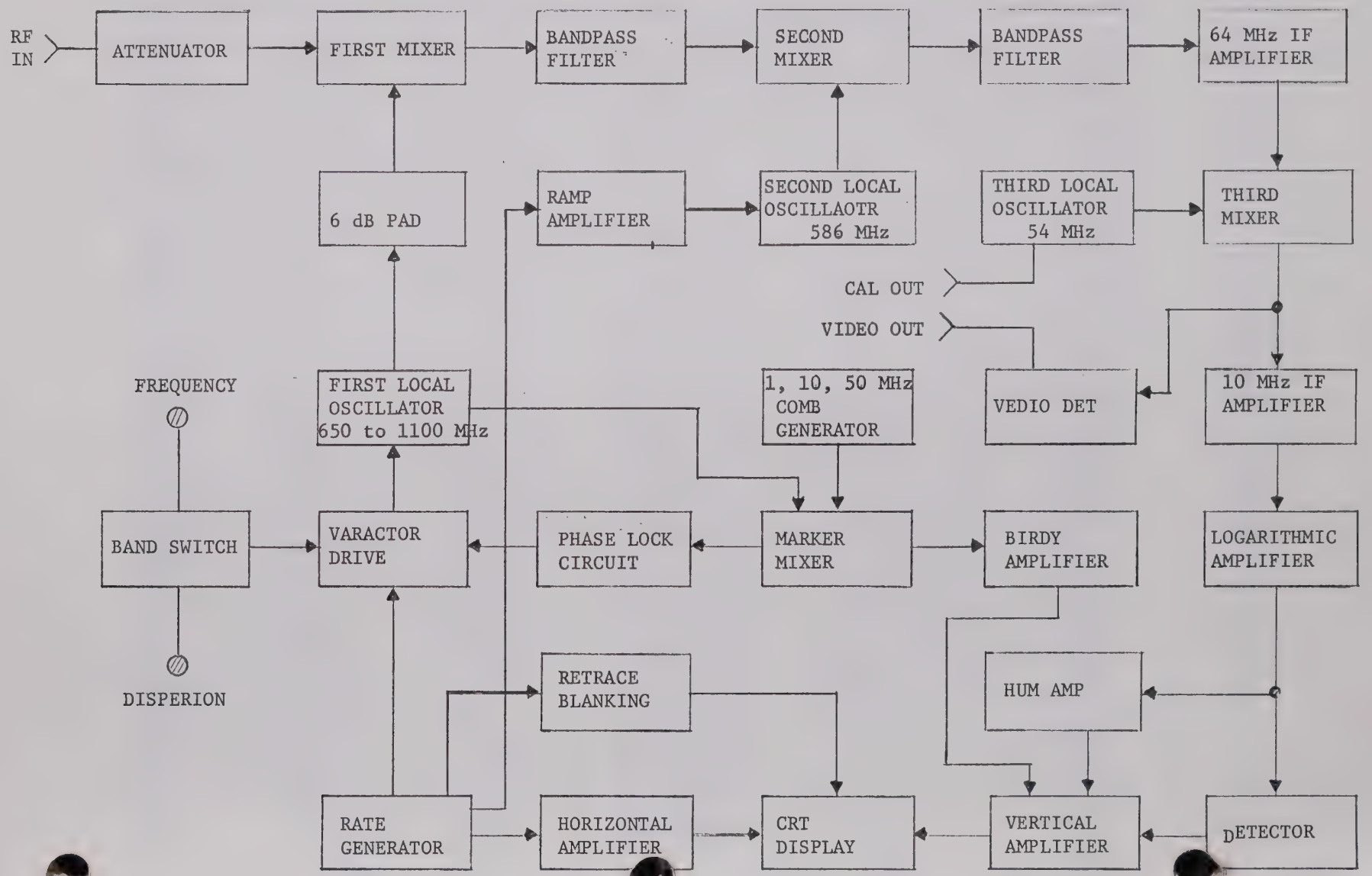


FIGURE 4: VSM-5B BLOCK DIAGRAM

2.8 64 MHz IF AMPLIFIER

This IF stage is a single integrated-circuit amplifier. Both the input and output are tuned to 64 MHz. The gain of the amplifier is adjustable over a 6 dB range, from the front-panel AMPL CAL control.

2.9 THIRD LOCAL OSCILLATOR AND CAL OUT

The third local oscillator is a crystal-controlled transistor oscillator operating at 54 MHz. The output of the third local oscillator is coupled to one input of the third mixer. The output of the 54 MHz oscillator is also coupled to the CAL OUT connector on the front panel. It provides a calibrated +10 dBmV signal level for amplitude calibration.

2.10 THIRD MIXER AND IF AMPLIFIER

The third mixer is a balanced mixer combining the 64 MHz output of the second IF and the output of the third local oscillator the resultant is then amplified by a transistor circuit, whose output is tuned to 10 MHz with a 200 KHz bandwidth.

2.11 LOGARITHMIC AMPLIFIER

The logarithmic amplifier is a monolithic IC consisting of two parallel 30 dB log amplifier stages that are summed in two differential outputs. The output is proportional to the sum of the logs of the input voltages to the two stages. The input signal from the 10 MHz IF amplifier is split between two limiting integrated-circuit amplifier stages that drive the logarithmic amplifier. The output of the logarithmic amplifier drives the detector amplifiers.

2.12 DETECTOR

The detector input consists of two differential-input, differential-output integrated-circuit amplifiers. Each IC drives a pair of hot-carrier diodes used as linear detectors. The two detector outputs are added, and the combined output drives the vertical amplifier. The front-panel LOG range switch selects either the 30 dB or 60 dB detector output range, each of which is obtained from a calibrated internal voltage divider.

2.13 VERTICAL AMPLIFIER

The vertical amplifier utilizes two operational amplifiers to drive a complementary pair of output transistors which drive the vertical deflection coil. A portion of the vertical output is sampled and fed back to the IC drive circuitry for gain stabilization.

2.14 RATE GENERATOR

The rate generator utilizes a pair of integrated operational amplifiers to generate the timed waveforms driving the horizontal amplifier and varactor drive circuits. Two modes of sweep operation may be selected by operation of the front panel AUTO/MAN switch. When the AUTO/MAN switch is in AUTO, the horizontal sweep rate is continuously variable from .3 to 30 Hz, and .03 to 3 Hz. The variable sweep rate of .03 to 3 Hz may be obtained by pulling the RATE/MAN control into the DIVIDE BY 10 position. When the AUTO/MAN switch is in MAN, the horizontal position of the trace is varied by rotation of the RATE/MAN control.

2.15 VATACTOR DRIVE

The varactor-drive circuit controls the voltage to the varactor diodes in the first local oscillator. It consists of two integrated-circuit amplifiers. The amplifier input consists of two additive voltage components, a DC component determined by the setting of the front-panel FREQUENCY control and the dispersion switch, and a triangular-wave somponent determined by the setting of the front-panel DISPERSION switch. The triangular wave is derived from the rate circuit. In phase lock operation the output of the phase lock circuit is coupled to the second amplifier stage.

The varactor-drive output voltage determines varactor-diode capacitance which in turn determines the frequency of the first local oscillator. The varactor drive is adjusted to provide a linear oscillator frequency characteristic on the CRT display.

2.16 HORIZONTAL AMPLIFIER

The horizontal amplifier consists of an operational amplifier driving a complementary pair of output transistors which drive the horizontal deflection coil. A sample of the horizontal deflection signal is fed back to the input of the operational amplifier for gain stabilization.

2.17 1, 10 and 50 MHz COMB GENERATOR

Three crystal controlled harmonic markers with frequencies of 1, 10 and 50 MHz are included in the Model VSM-5B. The birdies derived when the markers are mixed with the First Local Oscillator sample provide a precision method for monitoring frequency. (Marker accuracy of 0.01% $\pm$1 MHz is obtained) The $\pm$1 MHz portion of the error can be minimized by centering the fine tune control. Maximum precision is achieved when the birdy at 0 frequency is centered in the zero response bell with the Marker Cal control at 500 Hz resolution. The 1 MHz marker is divided by five to provide a 200 KHz reference for the phase lock loop.

2.18 MARKER MIXER

The output of the Comb Generator and the First Local Oscillator sample are heterodyned on the Marker Mixer. When the frequency of the First Local Oscillator is near a Comb frequency multiple a zero beat or birdy is produced.

2.19 BIRDY AMPLIFIER

The birdy information developed in the marker mixer is amplified and shaped in the Birdy Amplifier. The output of the Birdy amplifier is added to the Log Amp Detector output in the vertical amplifier.

2.20 PHASE LOCK CIRCUITRY

The phase lock technique compares the frequency and phase of the frist local oscillator to a 200 KHz reference oscillator. If the two signals differ in frequency and/or phase an error voltage is generated and applied to the first local oscillator, causing it to correct in the direction required for decreasing the difference. The correction procedure continues until lock is achieved, after which the first local oscillator will continue to track the reference. Because of the high frequency of the first local oscillator (650 to 1100 MHz) the phase sample cannot be developed directly. The first local oscillator phase sample is developed by heterodyning the 1 MHz comb generator and the first local oscillator. The 200 KHz reference is obtained by dividing the 1 MHz comb reference by five.

The phase lock circuitry operates for dispersions of 200 KHz/div. and less.

2.21 LOW-VOLTAGE POWER SUPPLY & BATTERY SAVER CIRCUIT

The primary power for the VSM-5B is an internal 12v battery. The low-voltage power supply provides six regulated voltages, +20, +11.3, +9, two +5.7 and -3.7v DC. The regulators drop the battery voltage to these required levels and maintain the regulated level against load fluctuation and input voltage variation due to battery discharge. The regulator circuits utilize operational amplifiers to drive the series pass regulator transistors. A separate charger/converter (paragraph 2.23) is available to allow recharge of the internal battery and/or operation of the VSM-5B from AC power mains. An INT-BAT-OFF-EXT BAT front panel switch is provided to select the internal battery supply or an external 12 to 15v DC, 1.5 amp power source. The battery saver circuit automatically disconnects the battery when it's voltage drops below 10v. This prevents complete discharge of the battery insuring longer battery life.

2.22 HIGH-VOLTAGE POWER SUPPLY

The high-voltage power supply provides a regulated 3750v DC to the CRT anode and control voltages to the various CRT elements. Operational amplifier circuitry and one transistor provide drive for the flyback transformer. A sample of the high-voltage is fed back to a series regulator circuit which controls the collector voltage of the flyback drive transistor. The variation of the drive-transistor collector voltage causes regulation of the high-voltage supply.

2.23 CHARGER/CONVERTER

A separate battery charger/converter is provided with each VSM-5B. It is powered from 115/130v, 60 Hz source, or a 220/240v source. The power source line voltage and frequency must match the charger/converter. Two DC outputs are provided. The battery charger output is regulated by an emitter-follower regulator at approximately +15v. The filtered converter output provides +12v to +20v. The charger/converter output cable is connected to the VSM-5B front panel EXT BATT ONLY connector.

2.24 WIDE BAND DETECTOR

The output of the third mixer is coupled to the wideband detector module, where it is amplified and detected. The detected output is then processed thru an offsetting IC stage and coupled to the front panel VIDEO OUT connector.

2.25 RETRACE BLANKING

The front panel retrace blanking switch allows for the selection of unblanking the retrace. Unblanking the retrace allows for more information to be displayed on the CRT at very slow rates.

2.26 HUM AMPLIFIER

This amplifier provides sufficient voltage to drive the vertical amplifier when making HUM measurements.

SECTION 3

OPERATING INSTRUCTIONS

3.1 INTRODUCTION

The following paragraphs describe the location and function of the front panel controls and preliminary operating procedures.

3.2 FRONT PANEL CONTROLS

3.2.1 RF ATTN (dB)

The attenuator provides up to 62 dB of attenuation to the input signal. The attenuator provides the following attenuation steps: 1, 2, 3, 6, 10, 20, and 20 dB.

CAUTION: The input to the attenuator must not exceed 1 watt average, and the output of the attenuator must not exceed 1 milliwatt average.

3.2.2 AMPL CAL

With the CAL OUT signal injected at the RF IN connector the AMPL CAL control is used to calibrate the graticule scale at +10 dBmV.

3.2.3 INT (intensity)

The intensity control adjusts the brightness of the trace.

3.2.4 VERT Position

The vertical position control adjusts the vertical position of the trace.

3.2.5 HORIZ Position

The horizontal position control adjusts the horizontal position of the trace.

3.2.6 FINE TUNE

The fine tune control tunes the VSM-5B at a very narrow dispersion.

3.2.7 COARSE TUNE

The coarse tune control tunes the VSM-5B over a range of approximately 5 MHz. In the phase lock mode of operation the coarse and fine tune controls tune the instrument because the frequency control is disabled.

3.2.8 EXT BATT ONLY

The external battery only connector provides a connector for an external power source or for a charger/converter.

CAUTION: DO NOT connect any AC power source to the internal/external battery input connector.

3.2.9 RF IN connector

The RF input connector is an "F" connector providing input to the VSM-5B RF attenuator.

3.2.10 VIDEO OUT connector

The video out connector couples the video amplitude from the VSM-5B wideband detector.

3.2.11 LOG RANGE switch

The log range switch selects a calibrated vertical display scale of either 30 dB or 60 dB. In the 30 dB position the scale at the left edge of the graticule (-20 to -50 dBmV) is used. In the 60 dB position, the scale at the right edge of the graticule (+10 to -50 dBmV) is used.

3.2.12 VIDEO FILTER switch

Reduces video filter bandwidth to 1000 Hz or 10 Hz when activated.

3.2.13 DIAL LIGHTS

When pressed, the dial light switch energizes the dial light and graticule lights.

3.2.14 CENTER FREQUENCY

The center frequency control permits continuous tuning of the VSM-5B from minimum to maximum frequency. The dial indicates the center frequency of the display.

3.2.15 MARKERS/PHASE LOCK

Individual switches control the 1, 10 and 50 MHz markers in the CRT display. For dispersions of 200 KHz/div. or less the phase lock switch locks the First Local Oscillator.

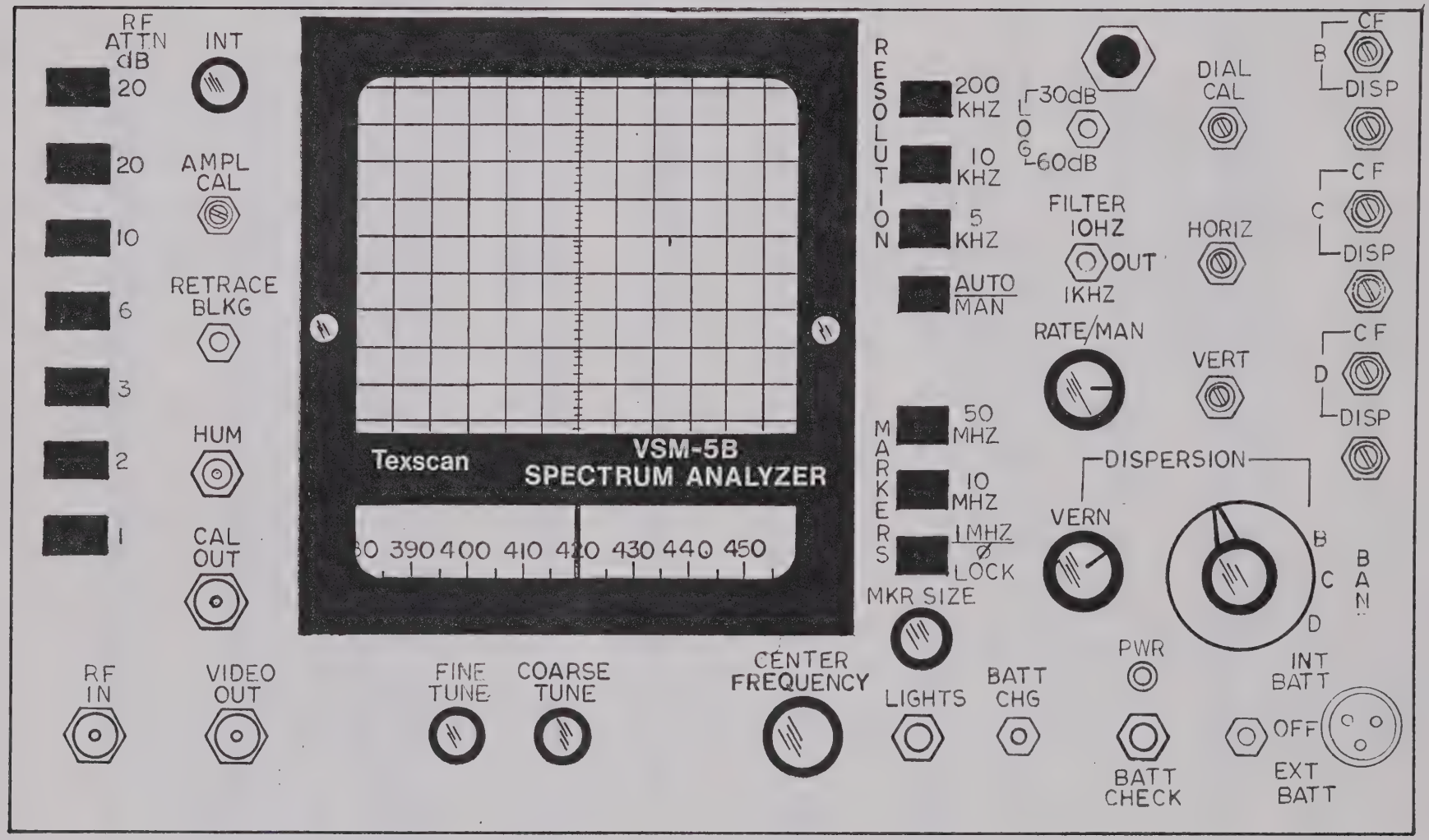
NOTE: Markers are not displayed in the 200 KHz or less dispersion position.

3.2.16 MARKER SIZE

Provides control of marker amplitude.

3.2.17 INT BATT/EXT BATT switch

The internal bettery, external battery switch selects the power source for the VSM-5B.


RF ATTN dB
20
20
10
6
3
2
1
INT
AMPL CAL
RETRACE BLKG
HUM
CAL OUT
RF IN
VIDEO OUT
Texscan
VSM-5B
SPECTRUM ANALYZER
390 400 410 420 430 440 450
FINE TUNE
COARSE TUNE
CENTER FREQUENCY
RESOLUTION
200 KHZ
10 KHZ
5 KHZ
AUTO MAN
MARKERS
50 MHZ
10 MHZ
1MHZ Ø LOCK
MKR SIZE
LIGHTS
BATT CHG
LOG
30dB
60dB
FILTER
10HZ
OUT
1KHZ
RATE/MAN
DIAL CAL
HORIZ
VERT
CF
B
DISP
CF
C
DISP
CF
D
DISP
DISPERSION
VERN
B
C
D
BAN
PWR
BATT CHECK
INT BATT
OFF
EXT BATT

3.2.18 DISPERSION MULTIPLIER

The dispersion multiplier selects the calibrated sweep width selected by the dispersion switch. The multiplier control continuously adjusts the spectrum width from 100 MHz to zero width when the dispersion switch is not in the Band B, C, or D position. The calibrated position is a switch detent at full clockwise rotation of the dispersion multiplier control.

3.2.19 DISPERSION

The dispersion switch selects one of the instruments three bands, CW, or preset bands B, C, or D.

3.2.20 RATE/MANUAL

The rate/manual control adjusts the variable sweep rate when the auto/manual switch is in AUTO. When the auto/manual switch is in MANUAL, the rate/manual control adjusts the horizontal position of the trace. The .03-3 Hz rate is obtained by pulling the rate/manual switch to the ÷10 position.

3.2.21 AUTO/MANUAL switch

The auto/manual switch selects internal circuitry to provide either a .03 to 30 Hz variable sweep rate or manual control of the sweep position.

3.2.22 RESOLUTION

Individual switches select the IF bandwidth of the VSM-5B at 200 KHz, 10 KHz and .5 KHz.

3.2.23 DISPERSION (B, C and D)

The three dispersion controls permit adjustment of dispersion width on the preset B, C and D bands.

3.2.24 CENTER FREQ (B, C and D)

The three center frequency controls permit adjustment of center frequency on the preset B, C and D bands.

3.2.25 BATT CHG

When activated, the battery charge switch permits battery charging from an external charger/converter.

3.2.26 BATT CHECK

When pressed, the battery check switch causes the display to deflect upward. Deflection above the display BATT LEV line indicates that battery charge status is satisfactory. Battery charge switch must be in the OFF position when checking battery level and the video filter should be in the 1 KHz position to eliminate any noise.

3.2.27 INTERLOCK

The interlock switch removes power from the analyzer when the top cover of the instrument is closed.

3.2.29 CAL OUT

Provides a reference signal level of +10 dBmV at 54 MHz. Used in conjunction with the AMP CAL control to set and check amplitude calibration accuracy.

3.2.30 DIAL CAL

Calibrates dial accuracy.

3.3 INITIAL SETUP AND CALIBRATION CHECK

It is advisable that the operator become familiar with the initial setup and calibration procedure. Thei procedure should become a standard routine to insure accurate and reliable measurements within the VSM-5B.

3.3.1

SET	TO
INT BATT-EXT BATT	OFF
RF ATTN (dB)	0 dB
INTENSITY	Mid-range
LOG RANGE	60 dB
VIDEO FILTER	OUT
CENTER FREQUENCY	0 MHz on dial tape
DISPERSION	1 MHz/div.
DISPERSION MULTR	CAL (fully CW)
RATE/MANUAL	30 Hz (fully CW and switch pushed in)
AUTO/MANUAL	AUTO
RESOLUTION	200 KHz

3.3.2

SET	TO
INT BATT-EXT BATT	INT BATT

Allow approximately 15 seconds warmup time.

3.3.3

SET	TO
INTENSITY	Required brightness
VIDEO FILTER	1 KHz
VERT	Position baseline trace on the CAL line of the graticule
VIDEO FILTER	OUT
HORIZ	Center the trace horizontally
BATT CHG	OFF

3.3.4 Press BATT CHECK. The base line should rise to some point above the BATT LEVEL indicated on the graticule. This is an indication of the state of charge contained in the battery. The BATTERY LEVEL is preset at the factory for a 11.5v charge level. If BATT CHECK indicates a level below the BATTERY LEVEL the charger/converter should be used to charge the internal battery.

NOTE: With the charger/converter connected to the VSM-5B set BATT CHG to the ON position. Press BATT CHECK. Note that the base line will rise and a ripple will appear in the base line. This indicates a charge voltage is being applied to the internal battery.

3.3.5 Adjust the CENTER FREQUENCY control until the ZERO response is displayed at center screen.

3.3.6 Activate the 50 MHz marker. Center the FINE TUNE control. Adjust the COARSE TUNE control so that the ZERO response peak is centered around the 50 MHz marker.

NOTE: This procedure calibrates the marker frequency for general use. For frequency identification to within ±100 KHz see paragraph 4.2. It should be noted here that when making frequency measurements with the VSM-5B, that the accuracy of the measurement will depend upon how accurately the zero response is centered around the 50 MHz marker. Any adjustment of the FINE TUNE and/or COARSE TUNE controls after the zero centering procedure will negate the calibration.

3.3.7 Connect a short 75Ω coaxial cable (RG-59) between the CAL OUT connector and the RF IN connector.

3.3.8 Adjust the CENTER FREQUENCY control for the response at 54 MHz. Adjust the AMP CAL control for a +10 dBmV signal level at 54 MHz. Check for vertical trace to be on CAL line. If not, use VERT control to recenter on CAL line. Repeat procedure as these controls interact. This calibrates the signal level circuitry of the VSM-5B.

3.3.9 Press DIAL LIGHTS. The lights behind the dial tape and the graticule lights should illuminate.

3.3.10

SET	TO
CENTER FREQUENCY	225 MHz
DISPERSION	45 MHz/div.

3.3.11 Remove the 75Ω cable between CAL OUT and RF IN. The VSM-5B is now displaying the spectrum form 4 to 450 MHz.

3.4 B, C AND D BAND SETUP PROCEDURE

Along with the normal dispersion settings on the VSM-5B, bands B, C and D were allocated for use where the operator may require test readings at certain frequency and bandwidth ranges throughout the test period. Bands B, C and D can be preset for a specific frequency and bandwidth which serves the operator in setup time.

It should be noted however that the drift rate and stability of the VSM-5B is limited due to the use of one turn potentiometers vs the normal ten turn center frequency potentiometer. The minimum bandwidth is limited to approximately 5 MHz and the Ø lock circuitry is disabled in the B, C and D band settings.

3.4.1 Perform steps in paragraph 3.3.1.

3.4.2 Set RF ATTN (dB) to 40 dB.

CAUTION: Input must never exceed 1 watt average. The output of the attenuator must never exceed +20 dBmV. Always insert 40 dB or more attenuation before connecting an input. After the signal is connected, attenuation may be reduced to produce an adequate display.

3.4.3 Set the DISPERSION control to band B.

3.4.4 Connect the signal desired and adjust the center frequency for band B until the signal is centered on the display.

3.4.5 Adjust the dispersion for band B in conjunction with either/or the 1, 10 and 50 MHz markers for the band width desired. With no further adjustment of the center frequency and dispersion controls for band B the preselected center frequency and bandwidth may be acquired at any time by switching the DISPERSION control to the band B setting.

3.4.6 For preset of bands C and D use the same procedure described for band B.

3.5 OPERATION FROM EXTERNAL BATTERY OR CHARGER/CONVERTER

WARNING: At no time should a 115v AC power source be connected to the VSM-5B power input connector. (Refer to Figure 2)

3.5.1 Connect the power source selected to the EXT BATT ONLY connector.

NOTE: The VSM-5B will accept a power source of 12 to 15v DC. The power source must have at least 1.5 amp capability at full load.

3.5.2 Set the INT BATT/EXT BATT switch to EXT BATT.

3.6 BATTERY CHARGING

Battery charging may be accomplished with the internal battery contained in the VSM-5B.

3.6.1 Connect the CHARGER/CONVERTER to the EXT BATT ONLY connector.

3.6.2 Set the BATT CHG switch to the BATT CHG position (up).

NOTE: The CHARGER/CONVERTER will charge the battery from an end voltage of 11.5 volts to a full charge voltage of 12.5 volts in approximately 14 hours. The VSM-5B may be used for test purposes during this battery charge operation.

NOTE: The new CHARGER/CONVERTER aupplied with the VSM-5B has a battery charge indicator. The LED on the front panel of the CHARGER/CONVERTER will glow brightly with full charge current, as the charge current diminishes so will the brightness of the LED.

3.7 PHASE LOCK SYSTEM

Various tests and measurements require extreme stability of the test instrument involved. Obviously, oscillator stability could not be measured if the stability of the oscillator was greater than that of the test instrument. Therefore, the VSM-5B has been equipped with a phase lock system to provide maximum stability (200 Hz). The following procedure should be utilized to provide proper operation of the VSM-5B phase lock system.

3.7.1 Perform initial control settings paragraph 3.3.1 to 3.3.11.

3.7.2 Center COARSE and FINE TUNE controls.

3.7.3 Adjust CENTER FREQUENCY to approximate frequency of interest.

3.7.4 Adjust DISPERSION control to the 200 KHz position and readjust CENTER FREQUENCY until the display is centered on the screen.

NOTE: The Ø Lock system in the VSM-5B is functional only in the 200, 15 and 3 KHz positions.

3.7.5 Engage the Ø LOCK switch.

3.7.6 Recenter the display with the COARSE and FINE TUNE controls.

3.7.7 Adjust the RATE, DISPERSION and RESOLUTION controls to correspond to the band width of interest. Refer to paragraph 4.1.

NOTE: The following conditions should be noted when using the phase lock system:

a) CENTER FREQUENCY is disabled in the Ø Lock position, however, if the CENTER FREQUENCY control is moved too far while in Ø Lock the unit will "jump" lock. Therefore, when in the Ø Lock position, avoid using the CENTER FREQUENCY control. Use the COARSE nad FINE TUNE controls to adjust frequency while in Ø LOCK.

b) When the Ø Lock switch is engaged the display frequency may offset slightly to the left or right. This is normal operation. Use COARSE and FINE TUNE controls to readjust the display to center graticule.

3.8 AUDIO RECOVERY OPERATION

For VSM-5B units equipped with the Audio Recovery Option, this section describes operating procedures for proper audio reception. The VSM-5B may be used as a tunable FM or AM receiver with a 2 MHz window by performing the following steps:

3.8.1 Set DISPERSION control to 1 MHz/div and DISPERSION MULTR to CAL position. Tune the FREQUENCY control to the desired frequency with the aid of the dial and markers (see section 4.2).

3.8.2 Switch DISPERSION control to 200 KHz/div.

3.8.3 Engage Ø LOCK switch.

3.8.4 Set RESOLUTION switch to 10 KHz position.

3.8.5 Press the AUTO/MAN switch in for manual operation.

3.8.6 Now the operator can tune the VSM-5B with RATE/MAN control for a coverage of 2 MHz.

3.8.7 Locate the AM/FM switch and volume control on the fold-back cover and adjust these for proper operation.

3.8.8 If the VSM-5B has squelch function, set squelch switch to OFF position when setting up steps 1 through 7. The squelch feature is made operational by switching squelch switch to the ON position and adjusting the squelch level control to the desired threshold.

SECTION 4

OPERATING PROCEDURES AND APPLICATIONS

The VSM-5B Spectrum Analyzer is a swept heterodyne receiver that displays RF signals in the frequency domain. Signal frequency is measured in the horizontal direction, and signal voltage is the vertical direction of the calibrated CRT display. Because the VSM-5B is capable of revolving a broad spectrum of RF signals, it is especially applicable to CATV system measurements. The following paragraphs provide recommended setups and procedures for measuring CATV system performance in accordance with FCC technical standards. Most of the procedures are straight-forward, and satisfactory result should be easily attained. Others may require a brief period of familiarization.

4.1 INTRODUCTION

The following paragraphs illustrate some of the applications of the VSM-5B Spectrum Analyzer.

NOTE: One of the most common errors in conjunction with Spectrum Analyzers used is in the area of amplitude measurement.

The accuracy of the amplitude measurement is dependent upon rate timing, dispersion settings, and resolution settings. The interaction of these components may contribute to "scan loss", which can give the operator erroneous readings. Proper care must be taken therefore, to insure against "scan loss"; and insure greatest accuracy achievable in amplitude measurements.

The VSM-5B was designed to provide spectrum analysis of the 4 to 450 MHz range. This is a rather large bandwidth to cover in one 30 Hz per second sweep rate. With a resolution setting of 200 KHz the response time allowed for the vertical circuitry to display the signal at full sweep width is approximately 15 milliseconds. Due to the response of the vertical amplifier, signal amplitude is lost, therefore "scan loss".

We overcome "scan loss" in the VSM-5B by incorporating a variable rate control and a variable dispersion control. By slowing the rate speed and/or narrowing the dispersion the time allowed to display the vertical signal increases, therefore reducing "scan loss".

The general rule to follow is to reduce sweep rate and dispersion width until the vertical signal level displayed NO longer increase in amplitude. Decreasing the resolution will require further reduction of rate speed and dispersion width due to the reduction of bandwidth. Use of the video filter will require reduction of rate speed and dispersion width as the video filter limits the bandwidth of the vertical amplifier. When the operator becomes familiar with the interaction of the rate, dispersion, resolution and video filter controls in regard to "scan loss" the opportunity for error is amplitude measurements will decrease.

4.2 FREQUENCY IDENTIFICATION

The VSM-5B may be used along with the following procedure to identify signal frequencies to within ±100 KHz of their actual frequency.

4.2.1 Perform initial setup procedure in paragraph 3.3.1.

4.2.2 Turn on VSM-5B and permit unit to warm up 10 minutes.

4.2.3 Activate 50 MHz marker and center the peak of the zero response about the 50 MHz marker using the COARSE TUNE control.

4.2.4 Set RESOLUTION to 10 KHz and recenter the response over the marker.

NOTE: It may be necessary to narrow the sweep width by adjusting the dispersion vernier to get an accurate alignment.

CAUTION: Marker frequency has now been calibrated for ±100 KHz accuracy. DO NOT readjust FINE or COARSE TUNE controls as this will destroy calibration.

4.2.5 Set RESOLUTION to 200 KHz and DISPERSION to 45 MHz/div. DISPERSION vernier fully clockwise.

4.2.6 Adjust CENTER FREQUENCY control to desired signal.

4.2.7 Set DISPERSION to 1 MHz/div. and recenter signal response with CENTER FREQUENCY contorl.

4.2.8 Activate 50 MHz marker. Identify frequency of 50 MHz marker using dial tape reading.

4.].9 Note whether frequency of interest lies to the left or right of 50 MHz marker.

4.2.10 Adjust DISPERSION verier so that 1 MHz markers are as shown in Figure 5, while keeping frequency of interest displayed on the screen.

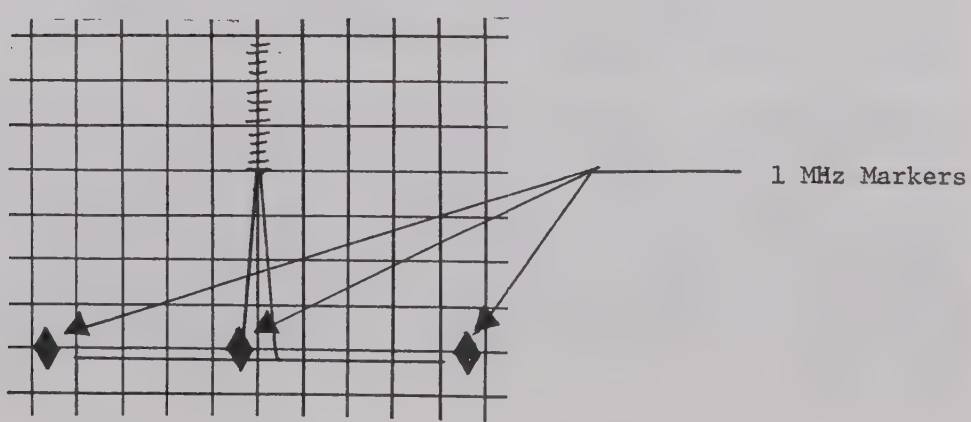


FIGURE 5

Unit is now calibrated for 200 KHz/div. By careful examination any signal response can be evaluated to within ±100 KHz of its actual frequency. (100 KHz represents 1/2 of a small graticule division)

4.3 AMPLITUDE MEASUREMENT

Measurement of signal levels is one of the basic functions of the spectrum analyzer. (See Table 3)

NOTE: Please read the note concerning amplitude measurements, paragraph 4.1.

4.3.1 Perform the initial setup procedure in 3.3.1 thru 3.3.11.

4.3.2 Apply the signal under test to the RF IN connector.

4.3.3 Set the DISPERSION control to 1 MHz/div.

4.3.4 Adjust the CENTER FREQUENCY control to place the signal under test in the center of the graticule.

4.3.5 Adjust the RATE/MAN control for a sweep rate setting as described in 4.1

4.3.6 Set the LOG RANGE switch to 60 dB.

4.3.7 Adjust the RF ATTN (dB) to produce an on-screen trace with a maximum amplitude of +10 dBmV as read on the graticule scale to the right of the screen.

4.3.8 The input voltage is the sum of the amplitude indicated on the graticule and the attenuation of the RF attenuator in dBmV. Read the scale on the right.

NOTE: The VSM-5B allows for operator calibration of the vertical signal (see paragraph 3.1 thru 3.11). The accuracy of the internal CAL signal is preset at the factory to be within ±.25 dB at 70° F. The scale is calibrated at +10 dBmV. Therefore for greatest accuracy in amplitude measurements, if signal strength is sufficient, use the RF attenuator to decrease the displayed signal as close as possible to the +10 dBmV graticule.

4.3.9 The VSM-5B is also provided with a 30 dB LOG RANGE. This scale should be used for lower signal levels.

4.3.10 Adjust the RF ATTN (dB) to provide an on-screen trace with a maximum amplitude of less than -20 dBmV as indicated on the graticule scale on the left of the screen.

4.3.11 The input voltage in dBmV is the sum of the amplitude indicated on the graticule and the attenuation of the RF attenuator. Read the scale on the left side of the graticule.

4.4 SPECIAL PURITY

4.4.1 Perform the initial setup procedure in 3.3.1 thru 3.3.6.

4.4.2 Apply the signal under test to the RF IN connector.

4.4.3 Adjust the RF ATTN (dB) and CENTER FREQUENCY controls to provide an on-screen trace.

4.4.4 Set the DISPERSION control to give the desired sweep width.

4.4.5 Examination of the desired signal and spurious responses is now possible. To determine the frequency and amplitude of these responses, perform steps 4.2 and 4.3 above.

4.5 RESIDUAL FM

4.5.1 Perform the initial setup procedure in 3.3.1 thru 3.3.6.

4.5.2 Tune the signal of interest to the center graticule.

4.5.3 Reduce the DISPERSION to 200 KHz.

4.5.4 Position the signal at center screen with the CENTER FREQUENCY control.

4.5.5 Depress the Ø Lock switch.

NOTE: Tuning is now accomplished via the COARSE and FINE TUNE controls. Do NOT use the CENTER FREQUENCY control.

4.5.6 Set RESOLUTION to 500 Hz.

4.5.7 Set the DISPERSION to 20 KHz/div. and recenter if necessary.

4.5.8 Reduce the SWEEP RATE to minimum by pulling the RATE/MAN switch and rotating it CCW.

4.5.9 The residual FM can now be determined by observing the width of the peak of signal in graticule divisions and multiplying by the dispersion.

4.7 ORIENTING ANTENNAS

The VSM-5B can be used to orient antenna systems for best reception.

4.7.1 Perform the preliminary setup procedures in 3.3.1 thru 3.3.5.

4.7.2 Attach the antenna downlead to the RF IN connector.

NOTE: If the antenna down lead system is other than 75Ω, an impedance matching transformer is required.

4.7.3 Adjust the DISPERSION control, and the CENTER FREQUENCY control to provide a display of the signals to be received.

4.7.4 Adjust the RF ATTN (dB) controls to provide an amplitude display of less than +10 dBmV.

4.7.5 Set the RATE/MAN control to a fast sweep rate and RESOLUTION to 200 KHz.

4.7.6 Rotate the antenna system and observe the position which produces the maximum signal level.

4.8 CALIBRATION OF FIELD STRENGTH METERS

The CAL OUT connector on the VSM-5B supplies a +10 dBmV $\pm$.25 dB calibrated source at 54 MHz that may be used to calibrate Field Strength Meters.

1) Connect the Field Strength Meter to the CAL OUT connector on the VSM-5B with 75Ω coaxial cable of known attenuation.

2) Adjust the Field Strength Meter to 54 MHz,

3) Calibrate the Field Strength Meter to +10 dBmV.

NOTE: Lower levels of calibration may be obtained by inserting a 75Ω pad (Texscan FP-75) in series with the CAL OUT connector. The accuracy of the pad must be taken into consideration when using this method.

4.9 AMPLITUDE MODULATION

Amplitude modulation is defined as modulation in which the amplitude of a wave is the characteristic subject to variation. Sidebands are produced about the carrier and the amplitude of these sidebands is directly related to the level of modulation (AM only). In the LOG mode this is expressed by the formula:

$$P_{sideband} - P_{carrier} = 20 \log (M/200)$$

Where: M = modulation in %
P = voltage in dBmV

(This procedure good for pure sine wave only)

EXAMPLE: 50 MHz signal at 10 dBmV levels amplitude modulated by 20 KHz signal.

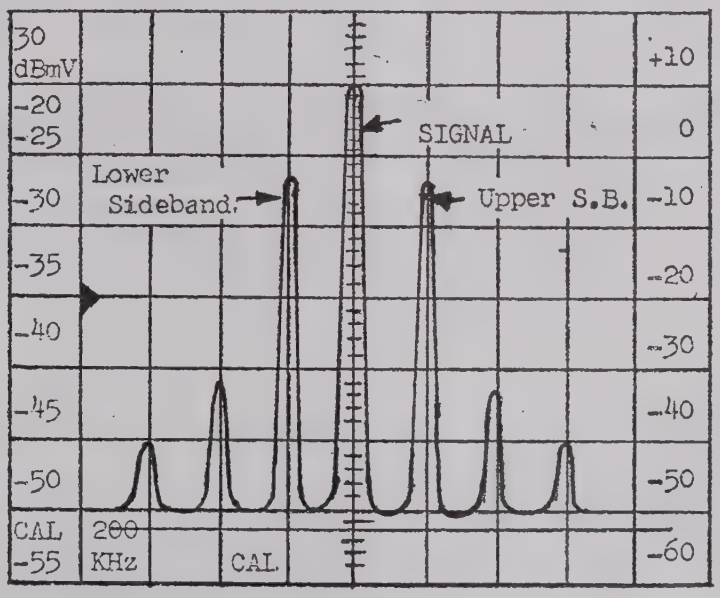


FIGURE 6

DISPERSION SET FOR 20 KHz/DIV
RESOLUTION SET FOR .5 KHz

Since the carrier and sidebands differ in amplitude by approximately 12 dB this results in a modulation level of 50%.

4.9.1 Perform the initial setup procedure in 3.3.1 thru 3.3.11.

4.9.2 Apply signal under test to the RF IN connector.

4.9.3 Adjust the CENTER FREQUENCY to display fundamental test signal at the center graticule. Adjust DISPERSION for a sweep width relating to the modulating signal. A general rule would be to set the DISPERSION for a setting equal to about one-fifth the modulating signal frequency.

EXAMPLE: 1) 15 KHz modulating signal should be set for 3 KHz dispersion.

2) 1 MHz modulating signal should be set for 200KHZ, etc.

Determine vertical amplitude of fundamental signal vs upper and lower sidebands. Use formula above to determine percentage (%) of modulation.

4.10 TEST AND ALIGNMENT OF FREQUENCY CONVERTORS

A frequency converter is a device that changes an alternating current from one frequency to another. Basic types of convertors are mixers, multipliers, detectors, etc. The VSM-5B is capable of analyzing many of the basic parameters of those types of devices.

4.10.1 Perform initial control settings in paragraph 3.3.1 thru 3.3.11.

4.10.2 Use CENTER FREQUENCY and DISPERSION controls to adjust for proper frequency range of device under test.

EXAMPLE: Double balanced mixer with LO 25 MHz at +50 dBmV and mixed with a 5 MHz +15 dBmV results in output shown in Figure 6. The two sidebands created 20 and 30 MHz show a conversion loss of approximately 7 dB. The local oscillator (25 MHz) has -60 dB isolation. 5 MHz signal has approximately -55 isolation. Second order distortion products at 15 to 35 are 48 dB down. See Figure 7.

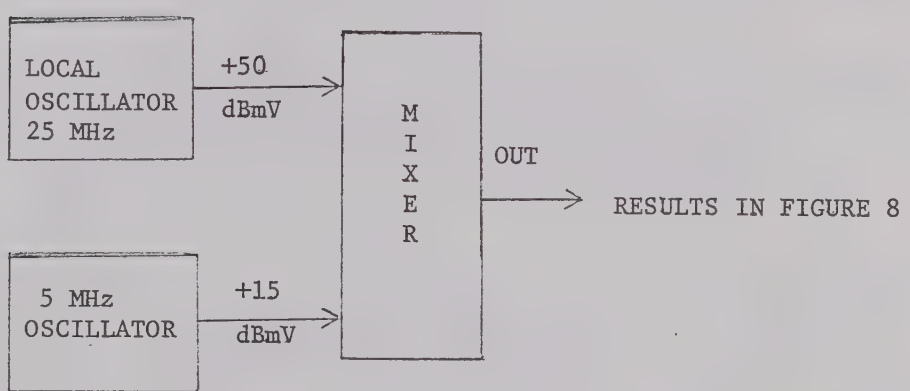


FIGURE 7

4.11 OSCILLATOR TEST AND ALIGNMENT

Since two of the basic parameters associated with oscillators are frequency and amplitude, the VSM-5B Spectrum Analyzer is well suited for oscillator test and alignment in the 4 to 450 MHz frequency range.

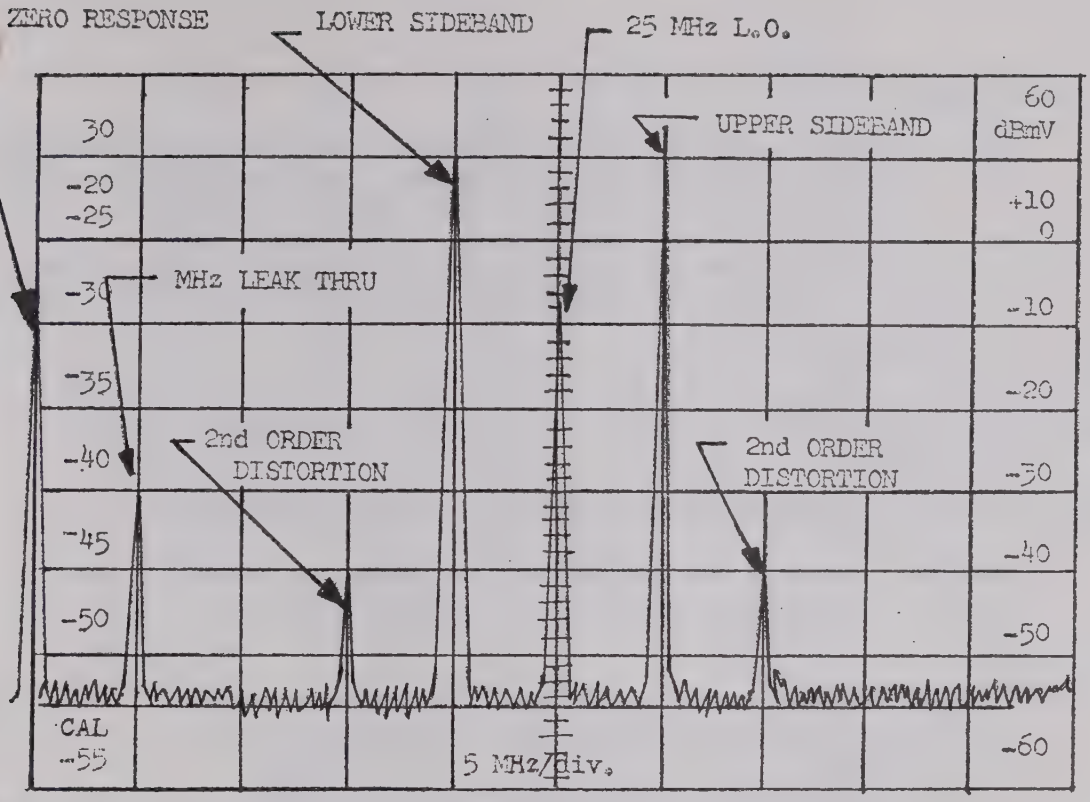


FIGURE 8

4.11.1 Perform initial control settings in paragraph 3.3.1 thru 3.3.11.

4.11.2 Reduce the RF ATTN until signal level is equal to or below +10 dBmV.

4.11.3 Adjust CENTER FREQUENCY vernier until the oscillators fundamental frequency is on center graticule.

4.11.4 The frequency dial tape will indicate the approximate frequency. More accurate frequency identification can be made by perfroming the frequency identification procedure in paragraph 4.2.

4.11.5 Oscillator amplitude can be determined by attenuating oscillator output level to a known reference level on the CRT.

EXAMPLE:

On-screen amplitude level	=	+10 dBmV
RF ATTN setting	=	30 dB
Actual amplitude level	=	+40 dBmV

4.11.6 Residual FM can be measured by dispersing the fundamental signal as follows.

4.11.7 Set DISPERSION switch to 200 KHz position.

4.11.8 Center the oscillators fundamental signal with the CENTER FREQUENCY control.

4.11.9 Engage ØLock.

NOTE: Signal may offset left or right of center when phase lock is engaged. This is normal operation. Use the COARSE and FINE TUNE controls to adjust signal to center screen.

4.11.10 Set DISPERSION switch to 3 KHz/div calibrated position and recenter frequency of interest if necessary with COARSE and FINE TUNE controls.

4.11.11 Set RESOLUTION to .5 KHz.

4.11.12 Slow SWEEP RATE until there is no further degradation of signal amplitude.

4.11.13 Set RET BLK to OFF (down) position.

EXAMPLE: Signal amplitude +9 dBmV in 2 KHz/div DISPERSION mode. Residual FM appears to be approximately 2 KHz. See Figure 9.

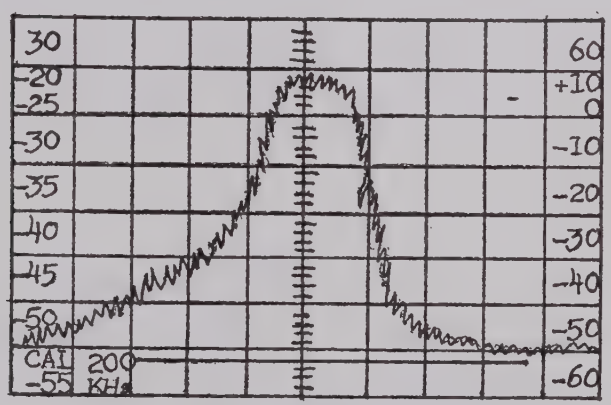


FIGURE 9

Spurious and harmonic content of the oscillator can be measured easily and accurately. See Figure 10.

4.11.14 Perform setup procedure in paragraphs 3.3.1 thru 3.3.11.

EXAMPLE: For fundamental frequency of oscillator at approximately 50 MHz, +10 dBmV output level.

2nd harmonic at 100 MHz, output level -22 dBmV therefore, 2nd harmonic is 32 dB below the fundamental frequency.

3rd harmonic at 150 MHz, output level -40 dBmV, (-50 dBmV) below fundamental.

4th harmonic at 200 MHz, output level -46 dBmV (-56 dB) below fundamental. See Figure 10.

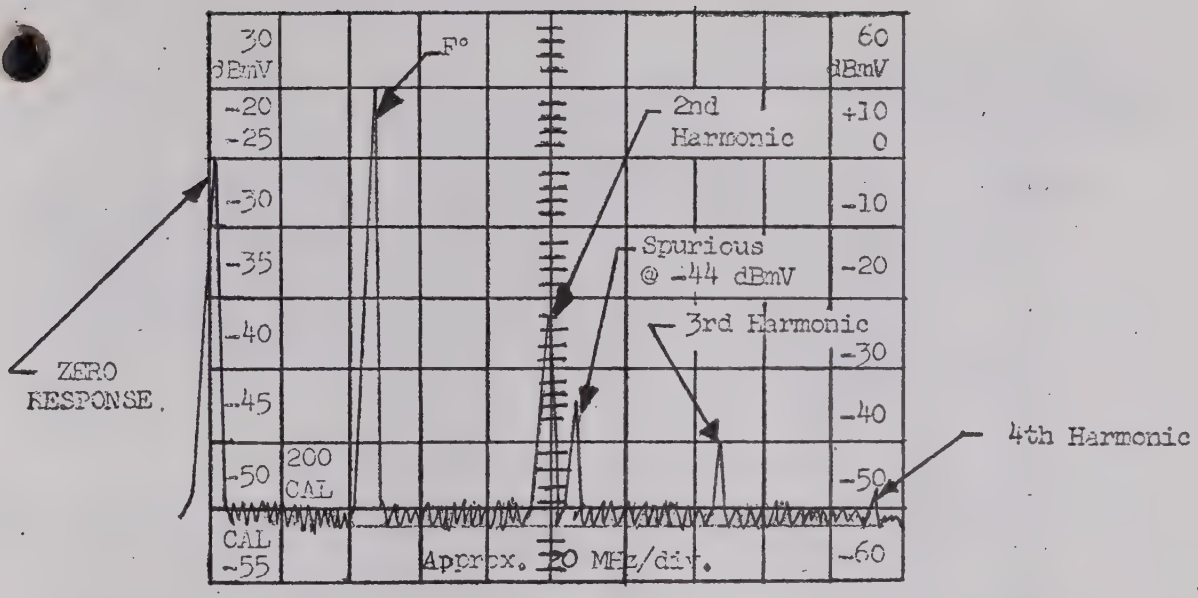


FIGURE 10

4.12 PRELIMINARY FOR CATV TESTING

4.12.1 Connect the EXT BATT or switch to INT BATT and energize the power switch. After about 10 seconds, the baseline should appear on the CRT. Permit unit to warm up 2 to 3 minutes.

4.12.2 Set INPUT ATTENTUATION to 40 dB.

4.12.3 Set DISPERSION switch to 100 MHz.

4.12.4 Adjust the CENTER FREQUENCY dial until the indicator is set to approximately 175 MHz.

4.12.5 Set the INTENSITY control for a pleasing display.

4.12.6 Set the SWEEP RATE control to 30 Hz position. (Fully clockwise)

4.12.7 Set the RESOLUTION switch to 200 KHz.

4.12.8 Set the VIDEO FILTER switch to 1 KHz.

4.12.9 The baseline should be on the CAL graticule line and it should be sharp. If not, adjust VERT, HORIZ, AND INTENSITY for a sharp, bright line on the CAL graticule.

4.12.10 Set the VIDEO FILTER switch to OFF.

4.12.11 Connect the signal under investigation to the RF IN connector.

CAUTION: This input must not exceed 1 watt average with INPUT ATTENUATION set at 40 dB.

4.12.12 The unit is now ready to perform spectrum analysis in the 4 to 450 MHz range.

IMPORTANT: Signal amplitude distortion occurs if the SWEEP RATE settings are too fast, or if DISPERSION settings are too wide for the 500 Hz IF WIDTH setting, or for the VIDEO FILTER setting. Avoid signal amplitude reduction by decreasing the SWEEP RATE setting until the displayed signal amplitude is constant and undistorted. Use the following table of control settings as a guide.

DISPERSION	SWEEP RATE		
	30 Hz	10 Hz	.03 Hz
	I F BANDWIDTH		
200 KHz	200 KHz	10 KHz	500 Hz
1 MHz	200 KHz	200 KHz	10 KHz
10 MHz		200 KHz	200 KHz
350 MHz			200 KHz
450 MHz			200 KHz

CAUTION: Input to the first mixer must not exceed +10 dBmV, or spurious signals will be generated. The sum of the on-screen signal amplitude in dBmV and the ATTEN setting in dB must not exceed +10 dBmV.

4.13 VISUAL CARRIER LEVEL MEASUREMENTS

4.13.1 Perform the initial control settings in paragraph 4.12 but adjust DISPERSION and CENTER FREQUENCY for a convenient display.

4.13.2 Connect RF IN connector to the desired system test point.

4.13.3 While observing the display, reduce the INPUT ATTENUATION in 10 dB steps until the maximum on-screen visual (PIX) carriers are at least 0 dBmV but less than +10 dBmV as indicated in the right-hand graticule scale.

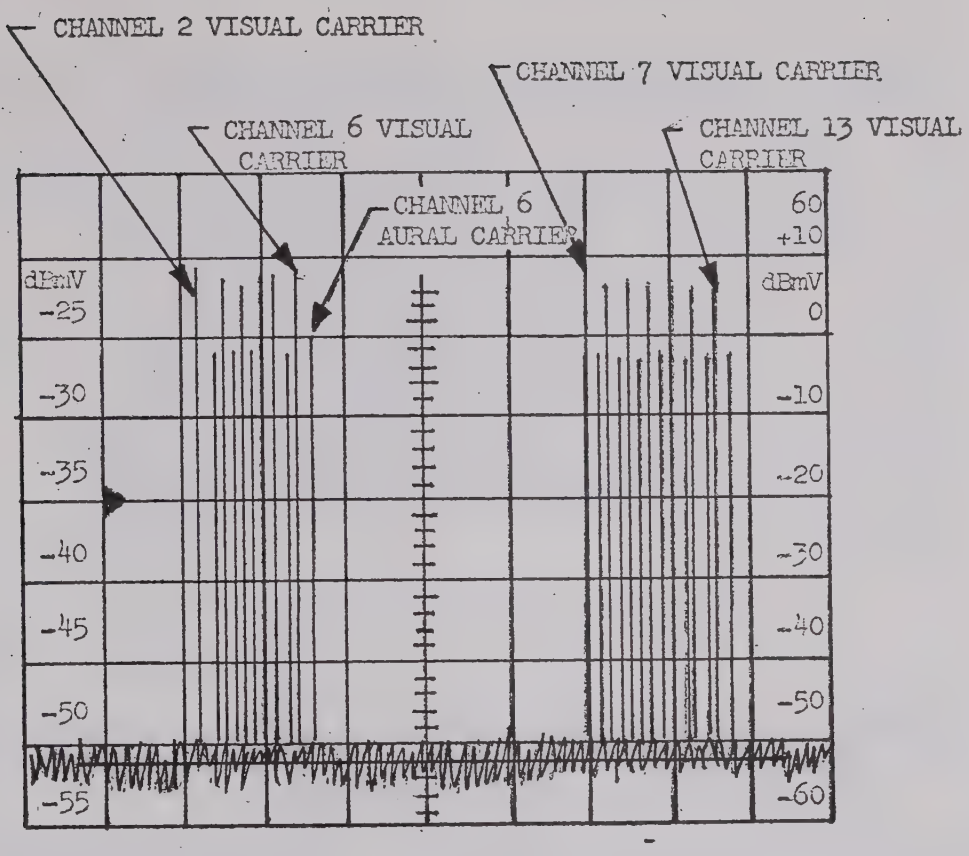


FIGURE 11

4.13.4 Use the small attenuation steps for aligning the vertical sync-peak of the maximum visual carrier to +10 dBmV or 0 dBmV horizontal graticule line. Dispersion must be reduced to see vertical sync pulses. See note.

NOTE: When measuring visual carrier levels, slow down the SWEEP RATE until the maximum visual carrier level is observed. This maximum level is the visual carrier plus the vertical sync pulses which ride the crest of the carrier. When the DISPERSION, RESOLUTION, and SWEEP RATE are reduced sufficiently, the vertical-sync roll-through can be observed on the visual carrier.

4.13.5 The acutal visual carrier level in dBmV equals the on-screen visual carrier level in dBmV + INPUT ATTENUATION setting in dB. (See Figure 9)

Example:

On-screen visual carrier level	=	10 dBmV
INPUT ATTENUATION setting	=	20 dB
Actual visual carrier level		+30 dBmV

4.13.6 Repeat steps 3 through 5 for other channel visual carrier levels.

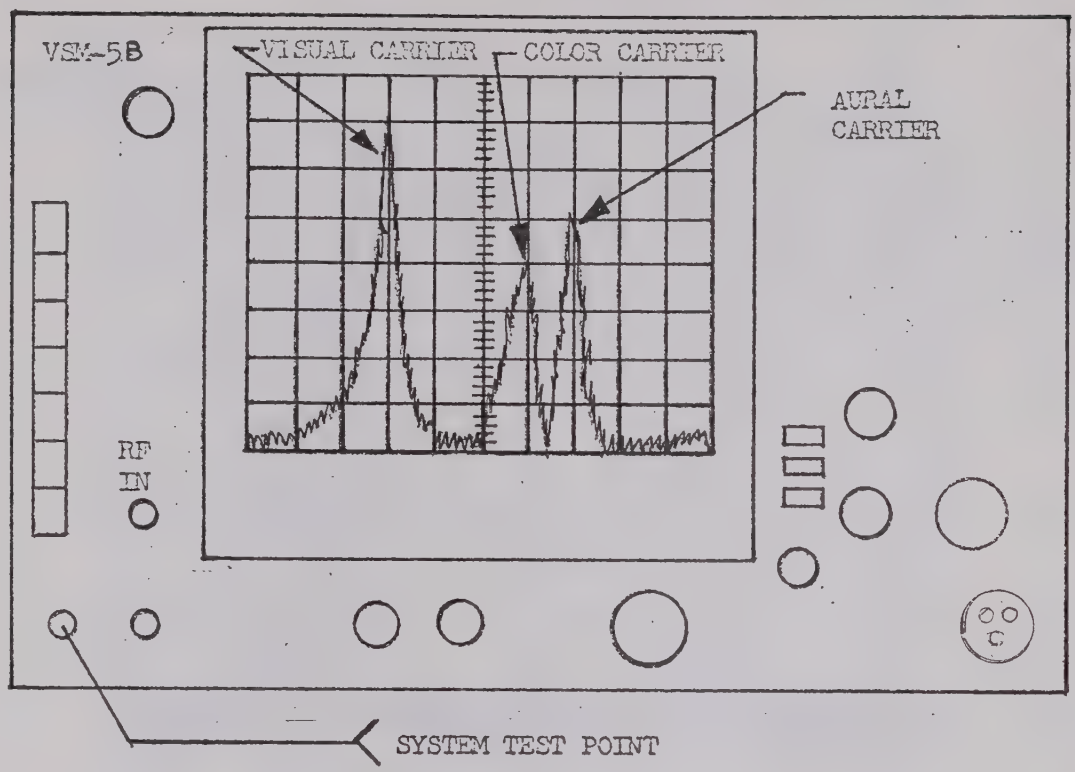


FIGURE 12

4.14 AURAL CARRIER LEVEL MEASUREMENTS (CATV)

4.14.1 Use the initial control settings in paragraph 4.12.

4.14.2 Connect the unit RF IN connector to the system test point.

4.14.3 Set the CENTER FREQUENCY dial to the desired channel center frequency.

4.14.4 Set the DISPERSION switch to 1 MHz and the vernier to maximum clockwise, in detent.

4.14.5 While observing the display, reduce INPUT ATTENUATION in 1 dB steps until the maximum on-screen visual carrier is at least 0 dBmV, but less than +10 dBmV.

4.14.6 Observe the aural (sound) carrier 4.5 MHz to the right of the visual carrier.

4.14.7 The difference between the on-screen visual and aural carrier levels should be 13 to 17 dB. Read the difference on screen, or add INPUT ATTENUATION until the visual carrier level equals the original aural carrier level. This is true only in CATV systems. MATV or off air signals may be different, therefore the aural level may be equal or larger.

NOTE: Avoid overload to first mixer by limiting the on-screen signal level to +10 dBmV.

Example 1: Using right-hand graticule scale.

On-screen visual carrier level	=	+10 dBmV
On-screen aural carrier level	=	- 6 dBmV
Difference in carrier levels	=	16 dB

Example 2: Using ATTENUATION control settings.
Total of ATTENUATION setting after decreasing visual carrier to original aural carrier level:

INPUT ATTENUATION setting	=	22 dB
ORIGINAL ATTENUATION setting	=	6 dB
Difference in settings equals difference in aural and visual carrier levels.		16 dB

4.15 SIGNAL-TO-NOISE MEASUREMENTS

Two methods are described. In Method 1, the visual carrier-to-noise (C/N) measurements are made on individual channels. In Method 2, the visual carrier-to-noise measurement is made over the full system frequency range.

Operate the analyzer so that visual carrier levels are at least +10 dBmV. Use the INPUT ATTENUATION control to limit on-screen visual carrier levels to +10 dBmV for carrier levels exceeding +10 dBmV.

4.15.1 METHOD 1: Channel-by-channel C/N Measurements

Use the control settings in paragraph 4.12 except as follows.

4.15.2 Connect the unit RF IN connector to a system test point.

4.15.3 Set the CENTER FREQUENCY to the desired channel center frequency. Example: Channel 7 (174-180 MHz), the center frequency is 177 MHz.

4.15.4 Set the DISPERSION switch to 1 MHz/div and the vernier for a 6 MHz display width. Use front panel 1 MHz MARKER to set sweep width, and then turn off the marker.

NOTE: 1 MHz markers will be easier to read by activating the VIDEO FILTER switch to 1 KHz.

4.15.5 Depress the VIDEO FILTER switch to OFF.

4.15.6 Set the RESOLUTION to 200 KHz.

4.15.7 Set the INPUT ATTENUATION control to provide an on-screen visual carrier level of from 0 to +10 dBmV, but do not exceed +10 dBmV. Record the displayed visual carrier level.

4.15.8 Shut down the headend channel processor for the channel under observation.

4.15.9 Measure the noise indicated by the rising baseline as INPUT ATTENUATION is reduced.

NOTE: If the noise level is too low to cause a noticeable rise in the baseline as the INPUT ATTN is reduced, insert a CHANNEL FILTER and a Texscan VSX-92 amplifier between the RF IN connector and the system test point. This filter prevents adjacent channel signals from overloading the analyzer. The amplifier is to boost gain so that a noticeable baseline rise will occur at lower noise levels. Repeat tests as necessary from step 3 after inserting the filter and amp.

4.15.10 The correct noise level (dBmV) is equal to the on-screen noise level (dBmV) and INPUT ATTENUATION (dB) +17 dB corrected factor.

NOTE: The correction factor accounts for the difference between the channel video noise bandwidth (4 MHz), the analyzer's IF noise bandwidth (200 KHz), and the LOG circuit response factor.

IF correction factor	=	$10 \log 10 \frac{4}{0.2}$	= 13 dB
Log circuit response factor	=		4 dB
Total cirrection factor	=		17 dB

NOTE: Log circuit response factor is due to the supression of noise spikes in the log circuitry. Thus the overall average noise response in the log circuit is less. The log circuit correction factor is 4 dB.

4.15.11 The carrier-to-noise level (dB) = the actual visual carrier level in dBmV (step 7) - the corrected noise level in dBmV (step 10).

EXAMPLE:

On-screen visual carrier level	=	5 dBmV
INPUT ATTENUATION	=	20 dB
Actual visual carrier level	=	+25 dBmV

- -

On-screen noise level	=	-30 dBmV
INPUT ATTENUATION	=	+ 0 dB
Correction Factor	=	+17 dB
Actual noise level	=	-13 dBmV

- -

Actual visual carrier level	=	+25 dBmV
Actual noise level	=	(+13) dBmV
Carrier-to-noise (C/N)	=	+38 dB

FCC technical standard: Signal-to-noise ratio = 36 dB minimum.

4.15.12 METHOD 2: Wide Range C/N Measurements

Use the control settings in paragraph 4.12, except as follows.

4.15.13 Connect the unit RF IN connector to a system test point.

4.15.14 Depress VIDEO FILTER switch to 1 KHz.

4.15.15 Set the INPUT ATTENUATION control to provide an on-screen display of visual carrier levels of up to +10 dBmV, but do not exceed +10 dBmV. Log the displayed visual carrier levels.

4.15.16 Shut down all headend processors except the pilots.

4.15.17 Decrease INPUT ATTENUATION settings until the baseline rises in the display. If baseline does not rise, see note 4.15.9.

4.15.18 Observe the shape of the noise trace. It may not be a straight line. Look at the point where the noise rises most within the normal channels, but ignore the noise outside these normal system channels. (see Figure 13)

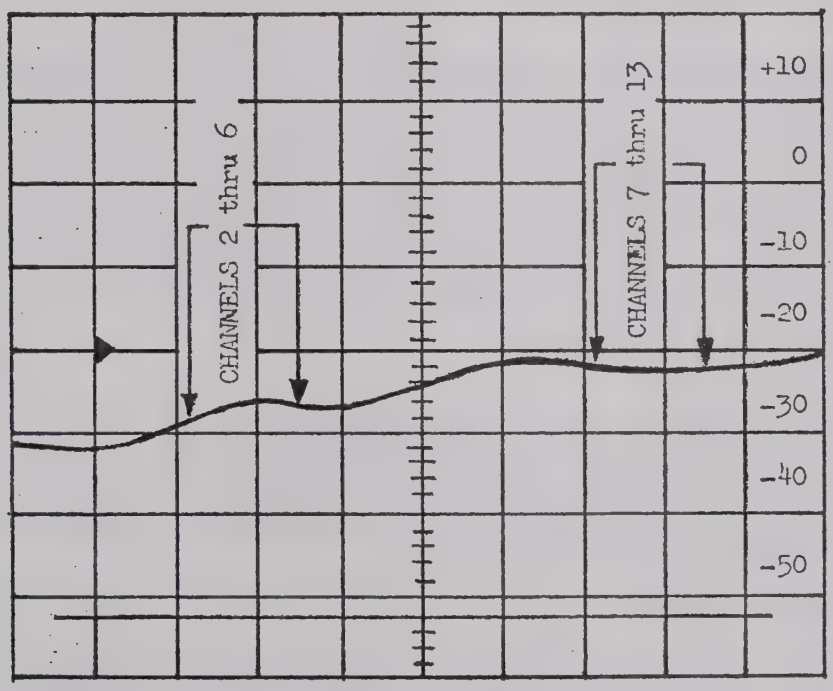


FIGURE 13

4.15.19 Calculate noise as in steps 10 and 11 of Method 1, beginning with the highest noise level, and the lowest visual carrier level.

NOTE: Noise levels are temperature dependent. Highest system noise levels are obtained on hot summer days in the mid or late afternoons.

4.16 CHANNEL FREQUENCY RESPONSE

There are several methods for measuring channel frequency response. Each method described here uses a VHF sweep generator, such as the Texscan VS-60B with slow sweep options, and the VSM-5B spectrum analyzer.

4.16.1 METHOD I (see Figure 14)

The sweep generator signal is injected at the input to individual headend processors and combined with the antenna signal. The sweep generator sweeps slowly through the system on a channel-to-channel basis at an RF level approximately 30 dB below the visual carrier level. The operator observes the slow sweep signal as it moves across the VSM-5B screen and determines that channel flatness is within ±2 dB. Use the 30 dB log mode or linear mode from the VIDEO OUT.

4.16.2 METHOD II (see Figure 15)

The sweep generator is injected directly into the individual headend processors on a channel-to-channel basis, but the antenna of the channel being swept is not connected. The sweep generator signal level is set at a level that does not exceed that of the visual carrier. The VSM-5B is set up as in Method I. Method II eliminates the measurement problem at carrier frequencies, but it does shut down the channel program during measurement. During this test, the standby carrier for the channel und test must be disabled, usually by pulling the crystal. Use the 30 dB log mode or linear mode from the VIDEO OUT.

4.16.3 METHOD III

In this method, two setups and procedures are required. The headend response and the distribution system response for individual channels are added to determine the unflatness for the entire system from antenna input to the system test point. The sum of the two responses for a given channel must be flat within ±2 dB.

4.16.3.1 HEADEND RESPONSE

Use the setup in Figure 16. Set the sweep generator for line sweep rate, the center frequency for channel center frequency, and the sweep width for 6 MHz cahnnel width. Use markers to identify system frequency. Set the RF output to provide a signal level equal to the cahnnel visual carrier level. Obtain a graph or photograph of the oscilloscope display of channel frequency response whose X-axis is calibrated in frequency and whose Y-axis is calibrated in dB. Carry out this procedure for each system channel to obtain the flatness of the entire headend. Perform these measurements when program material is not being transmitted.

4.16.3.2 DISTRIBUTION SYSTEM RESPONSE

Use the setup in Figure 17. In this case, the flatness of the entire distribution system on a channel-by -channel basis is obtained. The sweep generator is set for the same channels as in step 1, but at a very low sweep rate, several seconds per channel. The RF output is set to provide a level 20 dB below the visual carrier level for each channel.

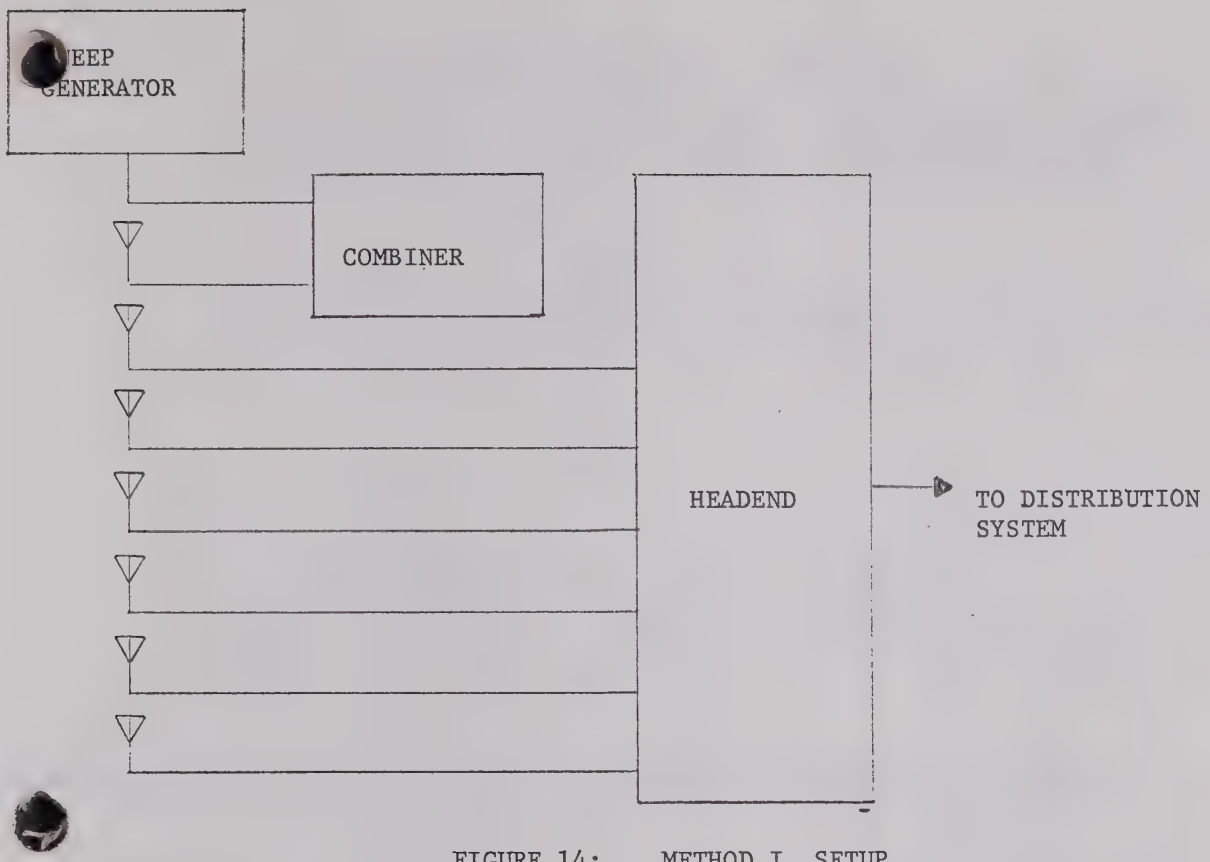


FIGURE 14: METHOD I SETUP

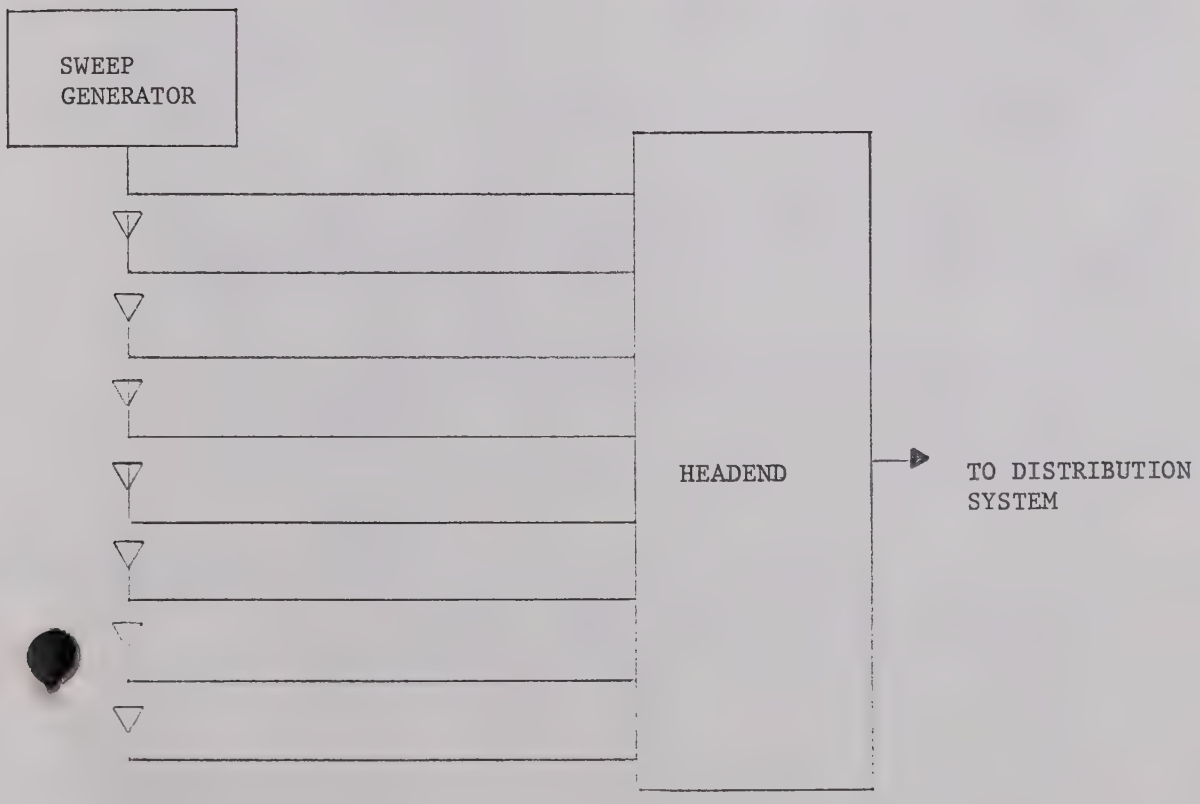


FIGURE 15: METHOD II SETUP

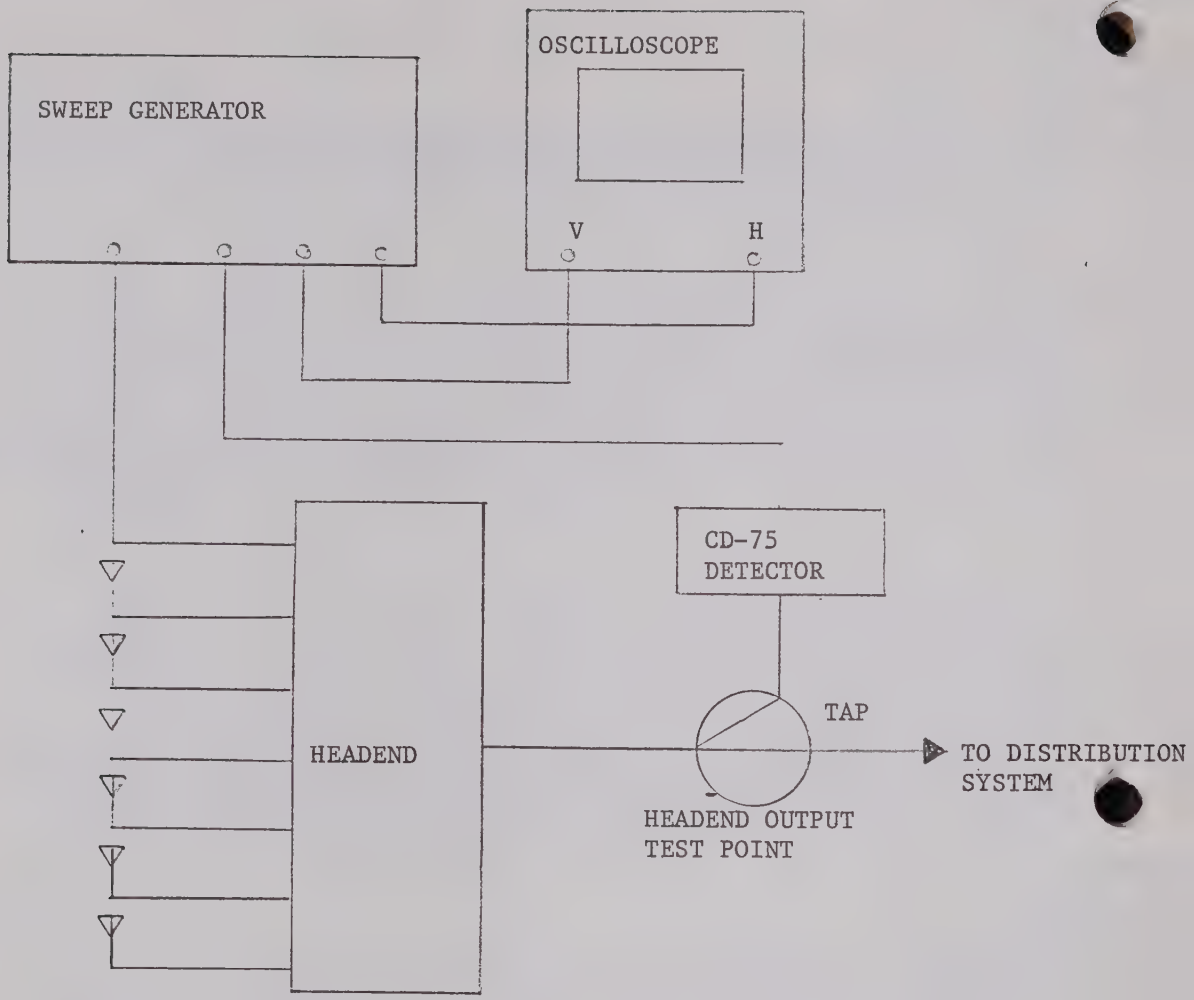


FIGURE 16: SETUP FOR HEADEND FLATNESS

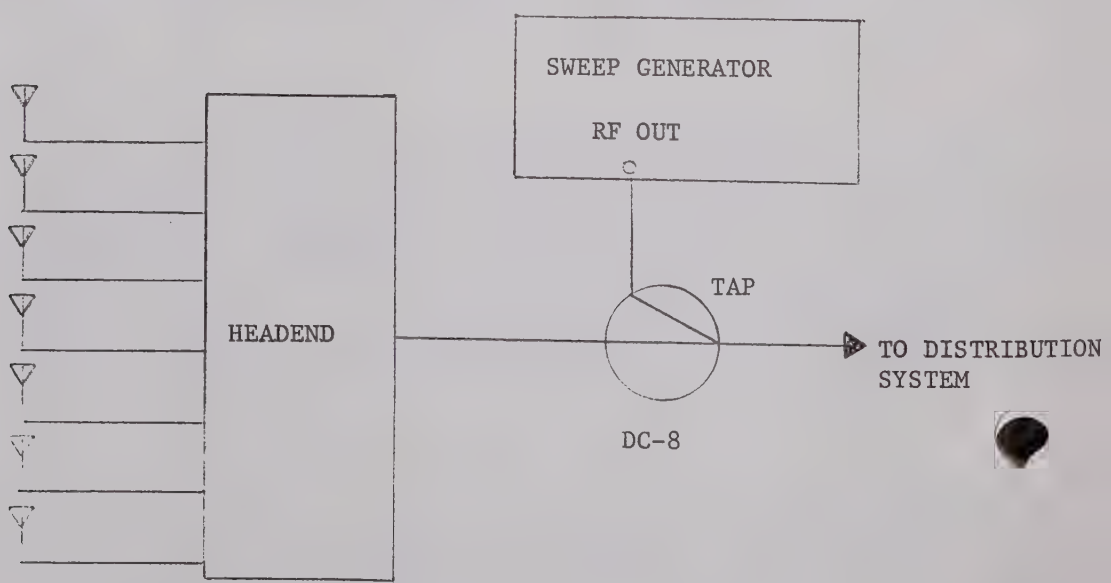


FIGURE 17: SETUP FOR DISTRIBUTION FLATNESS

The VSM-5B is connected to a system test point in the field. The controls are set to obtain a graph or photograph of the frequency response on a channel-by-channel basis as the slow sweep signal moves across the VSM-5B display. These measurements are made during regular program transmissions.

4.16.3.3 TOTAL SYSTEM FREQUENCY RESPONSE

The graphs obtained from corresponding channels in steps 1 and 2 are added to obtain the overall system response. See example in Figure 18.

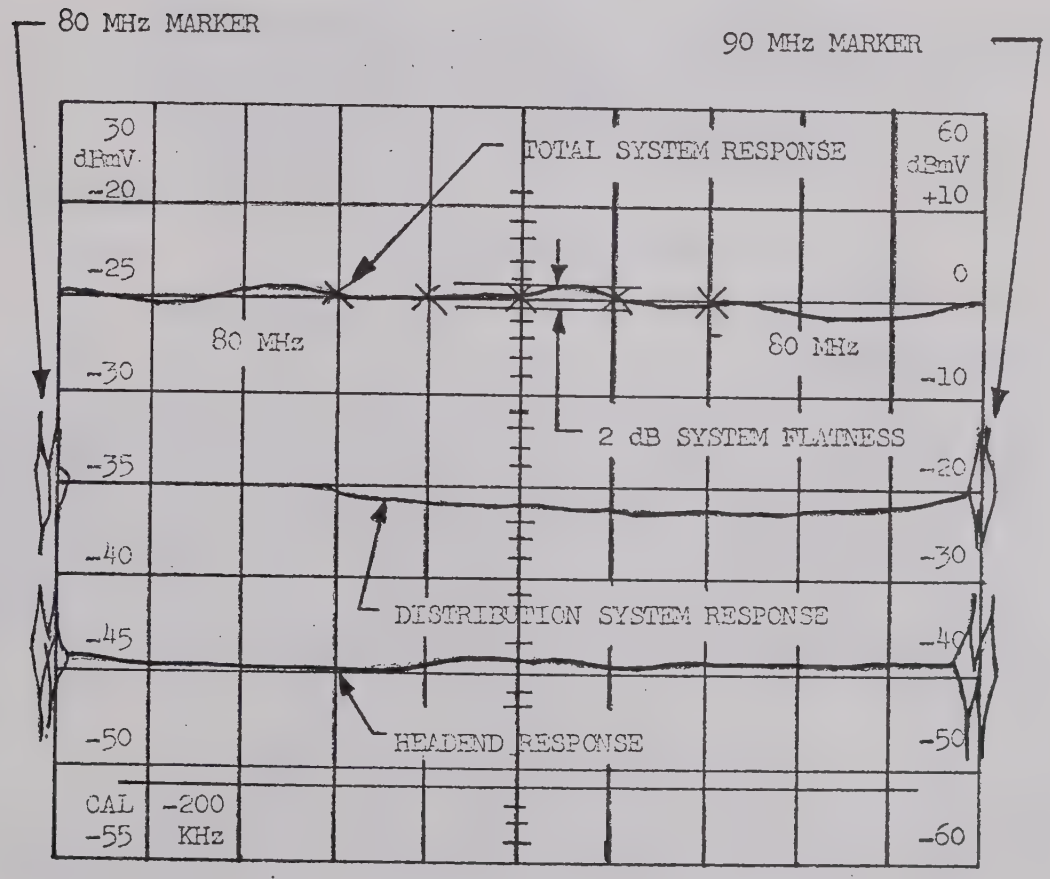


FIGURE: TOTAL SYSTEM RESPONSE OF CHANNEL 6

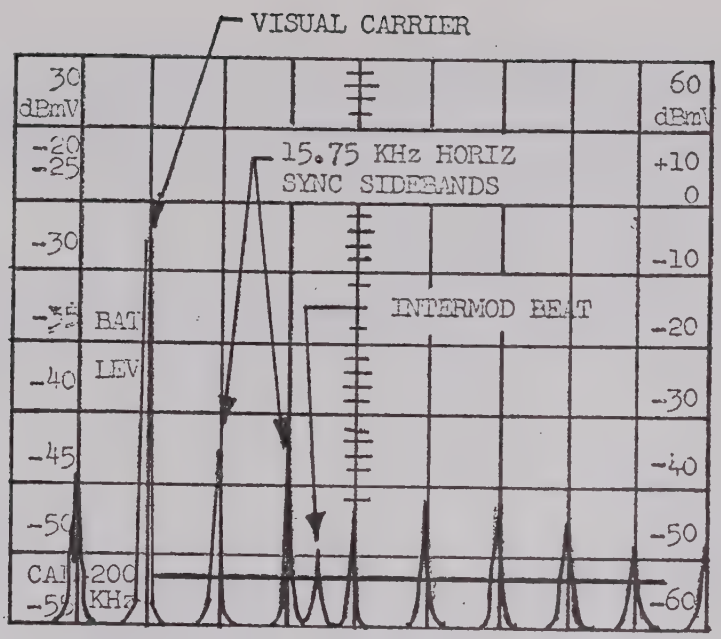


FIGURE 19: INTERMOD BEAT

4.17 INTERMODULATION

Two procedures are required to measure the intermodulation beats. Beats that are well away from the visual carrier are more easily resolved than those interspersed with horizontal sync sidebands that are near the visual carrier. All intermod beats should be measured at a point in the system where visual carriers are at least +10 dBmV. A sufficient input attenuation setting will prevent the VSM-5B from overload which results in additional displayed beats. Look for any stray apparent carriers in the passband of active channels only. Insert a bandpass filter for the signal of interest between the system test point and the VSM-5B RF INPUT.

4.17.1 METHOD I INTERMOD BEATS FAR FROM VISUAL CARRIER

4.17.1.1 Perform initial control settings in paragraph 4.12.

4.17.1.2 Set the CENTER FREQUENCY control to the desired channel center frequency.

4.17.1.3 Set the DISPERSION switch to 1 MHz/div and the DISPERSION vernier to produce a sweep width of at least 6 MHz.

4.17.1.4 While observing the VSM-5B display, reduce INPUT ATTENUATION in 20 dB steps until the on-screen visual carrier level is slightly less than +10 dBmV.

4.17.1.5 Measure the difference in amplitude between the vertical sync-tip level of the visual carrier and the intermod beat level within the channel. EXAMPLE:

Visual carrier sync-tip level	+8 dBmV
Intermodulation beat level	-(-41) dBmV
Difference	49 dBmV

is difference should be 46 dB minimum to fulfill FCC technical standards.

4.17.2 METHOD II INTERMOD BEATS CLOSE TO VISUAL CARRIER

Measurement of intermod beats close to the visual carrier is a tedious process. It is advisable to narrow the search to a particular channel by connecting a TV receiver to the system test point. Beats of sufficient level to cause a grainy picture at a given channel setting should be investigated using the VSM-5B.

4.17.2.1 Set the SWEEP RATE to .03 position.

4.17.2.2 Set RESOLUTION to .5 KHz.

4.17.2.3 Adjust DISPERSION vernier in a CCW direction and observe a progression of 15.75 KHz sidebands produced by the horizontal sync pulses. Continue to adjust the vernier and the HORIZ position control until the sidebands are aligned on the vertical graticule lines.

4.17.2.4 Look for an intermod beat or carrier between the equally spaced 15.75 KHz sidebands. See Figure 19 and 20.

EXAMPLE:		
	Visual carrier sync-tip level	+ 7 dBmV
	Intermodulation beat level	-(-39)dBmV
	Difference	46 dB

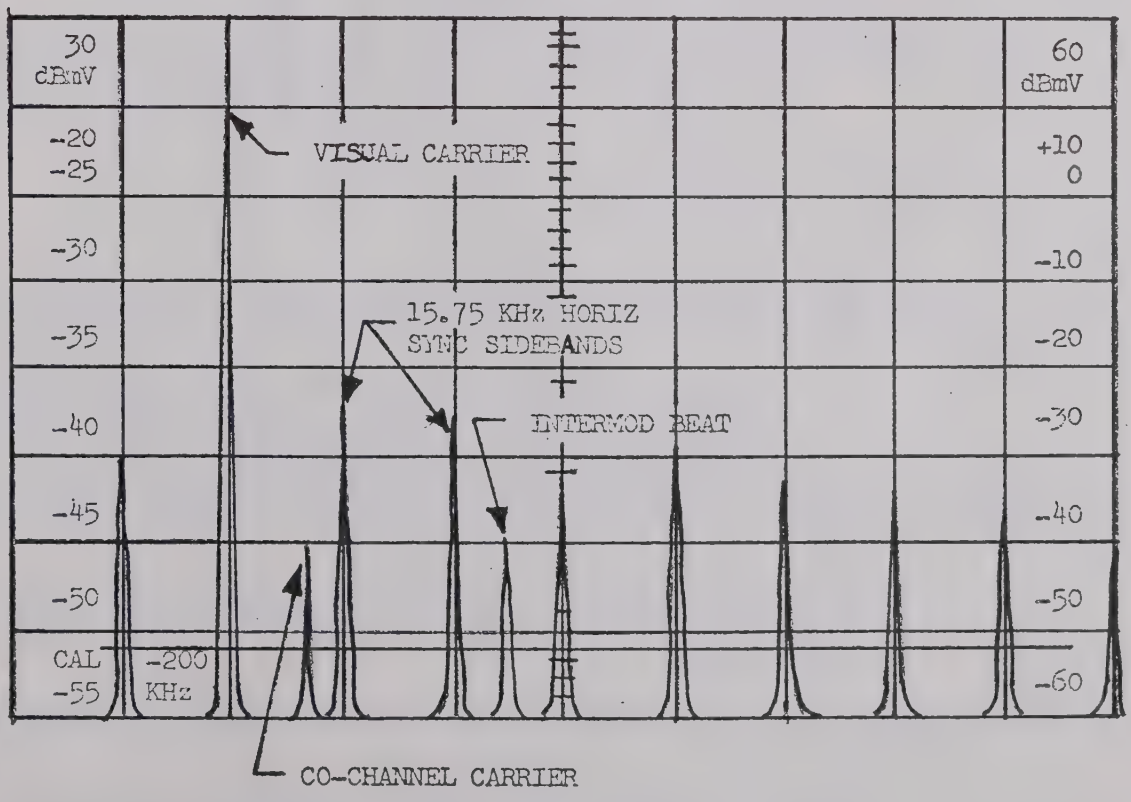


FIGURE 20

4.18 CO-CHANNEL

Use the procedure described in Method II of the intermodulation beat measurement in paragraph 4.17.2. The Co-Channel carrier will be located 10 KHz or 20 KHz above or below the visual carrier.

EXAMPLE: (see Figure 20)

Visual Carrier Level	+10 dBmV
Co-Channel Carrier Level	-(-40) dBmV
Difference	50 dB

This difference should be 46 dB minimum to fulfill FCC technical standards.

4.19 CROSS MODULATION

The cross modulation of a given system channel is derived from a two step measurement procedure. The cross modulation expressed in dB is the difference between the two measurements.

STEP 1: Measure cross modulation level with respect to the visual carrier level.

a. All system visual carriers, except that of the channel of interest are 100 percent amplitude_modulated by a 15.75 KHz square-wave, 50% duty cycle.

b. (1) Insert a channel filter - Texscan LSE or VF series for the channel of interest between the VSM-5B and the system test point.

(2) Set SWEEP RATE to .03 Hz position.

(3) Set RESOLUTION to .5 KHz.

(4) Set RETRACE BLANKING to OFF position. This provides a brighter trace for viewing the trace in both directions.

(5) Set DISPERSION switch to 200 KHz. Center VIDEO CARRIER on display. Energize Ø,LOCK. Readjust VIDEO CARRIER to center screen with COARSE & FINE TUNE controls.

c. Obtain a display of the channel visual carrier and the progression of 15.75 KHz sidebands.

d. Observe and record the difference in dB between the first (maximum) 15.75 KHz sideband level and the channel visual carrier level.

STEP 2: Measure the effective modulation level with respect to the visual carrier level.

a. All system visual carrier levels including the channel of interest are 100 percent amplitude modulated as in Step 1.

b. With the VSM-5B controls set as in Step 1, obtain a display

of the channel visual carrier and the progression of 15.75 KHz sidebands.

c. Observe and record the difference in dB between the first (maximum) 15.75 KHz sideband lock and the channel visual carrier level.

STEP 3: The difference between the recorded readings in Step 1 and Step 2 is the cross modulation expressed in dB.

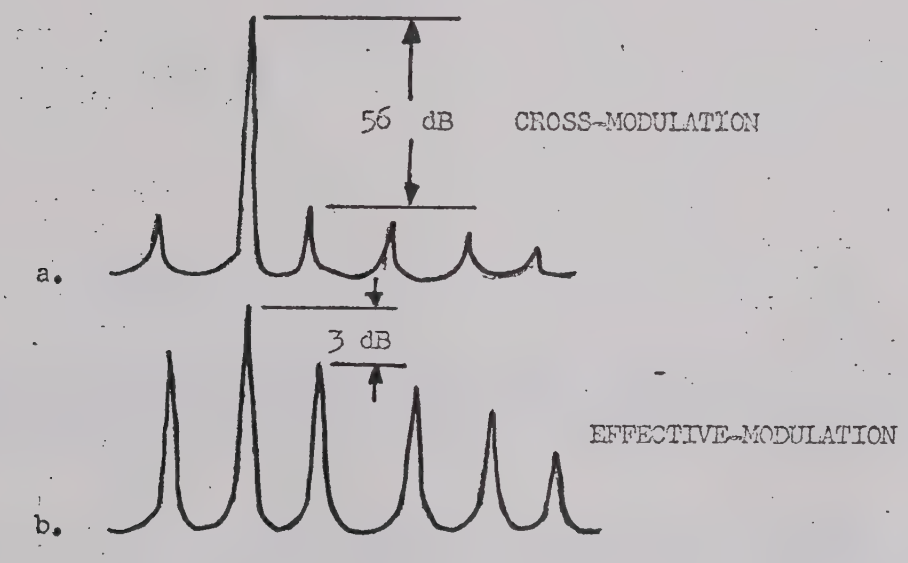


FIGURE 21; CROSS MODULATION MEASUREMENT

Cross modulation level w/ respect to visual carrier level	-56 dB
Effective modulation level w/ respect to visual carrier level	-(- 3)dB
Cross modulation	-53 dB

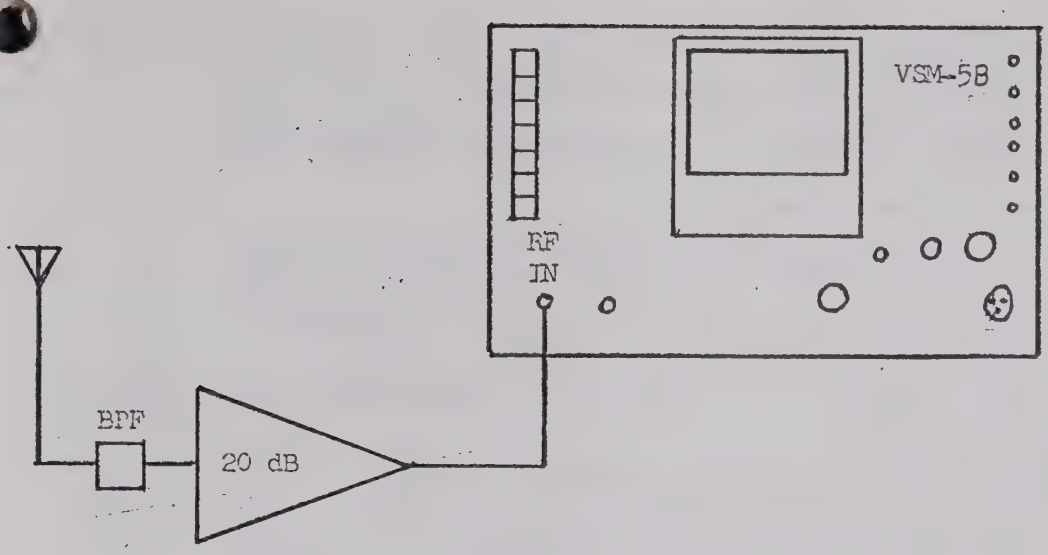


FIGURE 22: LEAKAGE MEASUREMENT

4.20 LEAKAGE MEASUREMENT

Leakage measurement with the VSM-5B is similar to the setup and procedure used with a signal level meter such as the Texscan Model 7272. The VSM-5B has the advantage over the 7272 because the operator can observe the signal he is measuring.

Because of the low signal levels to be measured, a high quality amplifier is required such as Texscan VSX-92. The return loss match should be at least 16 dB, and the gain should be at least 20 dB. Preamplifiers with headend type specifications, or integrated circuit type line extender amplifiers are desireable. The antennas used must be half wave dipoles out, or adjusted, to the channel center frequency, or a broadband antenna such as the Texscan broadband dipole antenna, Model AFS-1, adjusted to the center frequency. A 50-60-75 ohm balun is used and a calibration chart is provided which converts signal voltage level to field strength in microvolts per meter for frequencies in the range of 20 to 200 MHz. (see Figure 23) 75-ohm half wave dipoles do not require impedance conversion networks. A bandpass filter encomposing the frequency required must be used such as Texscan LSE or VF filters. (see Figure 22)

4.20.1 Use the initial control settings in paragraph 4.12, but make necessary control adjustments to resolve the radiated visual carriers of the CATV system.

4.20.2 Orient the antenna for maximum display amplitude.

NOTE: Separating the radiated signal that leaks from the CATV system from direct transmitted signals is not practical. Perform measurements on channels where external signal levels are low enough to permit measurement of the CATV system leakage.

4.20.3 Field strength intensity is determined by the following equation;

$$E = \frac{0.021\ fv = CV}{G \qquad G}$$

WHERE: E = field strength μ v/m (microvolts per meter)

f = channel center frequency

V = input voltage to amplifier in μV

G = antenna gain factor = 1 for dipole (see Figure 24)

C = a constant depending on channel center frequency (see Table 2)

CHANNEL	f = MHz CENTER FREQUENCY	C = 0.021 f
2	57	1.20
3	63	1.32
4	69	1.45
5	79	1.66
6	85	1.79
7	177	3.72
8	183	3.84
9	189	3.97
10	195	4.10
11	201	4.22
12	207	4.35
13	213	4.47

TABLE 2

EXAMPLE:

On-screen radiated signal level	-30 dBmV
Input Attenuation setting	0 dB
Actual VSM-5B input radiated signal level	-30 dBmV
Amplifier gain	-20 dB
Amplifier input signal level	-50 dBmV

Amplifier input voltage from Table 4		3.16 µV
Channel 2 nultiplying factor from Table 5		1.2
Antenna gain (for 75Ω dipole)		1.0
Field strength (E) = 1.2 x 3.16 µV	=	3.79 µV/m

FCC Technical Standards for Radiation:

Up to 50 MHz	15 µV/m maximum at 100 feet
54 to 216 MHz	20 µV/m maximum at 10 feet
Above 216 MHz	15 µV/m maximum at 100 feet

4.21 HUM MODULATION

To measure hum or low frequency variations, transmit a pure CW signal into the system, such as an unmodulated pilot generator. Make sure PCG has no hum of it's own as this would add into the measurement and give a false indication of system hum.

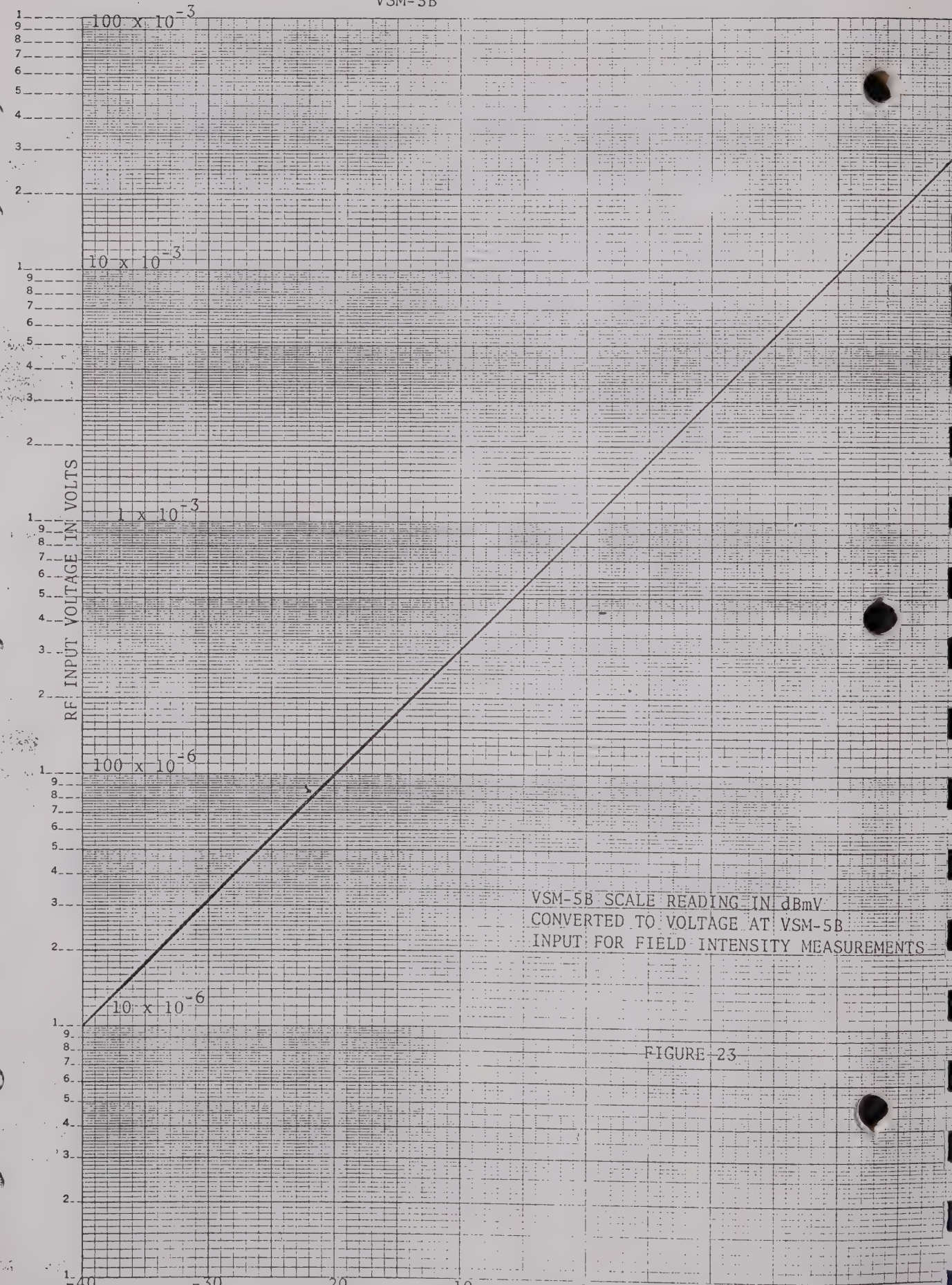
4.21.1 Perform the initial setup in paragraph 4.12.

4.21.2 Set the CENTER FREQUENCY to observe the pure CW carrier.

4.21.3 Set RESOLUTION switch to 200 KHz, and set the DISPERSION to the CW position.

4.21.4 Set display amplitude between +10 and -10 dBmV, by using the input attenuator.

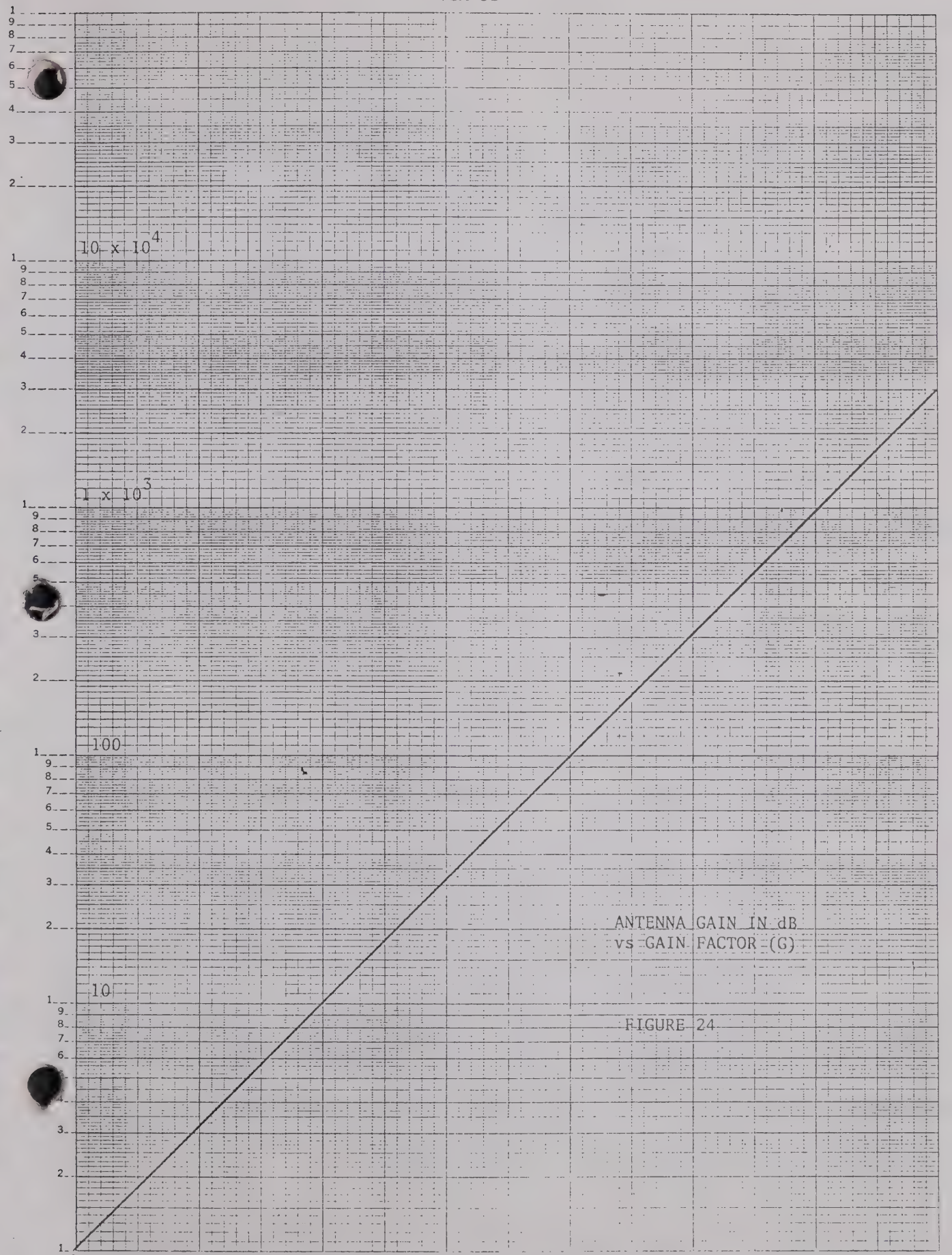
4.21.5 Slow sweep rate. Depress the HUM switch. If there is any amplitude modulation by hum in the system, the horizontal line will not be flat. Determine the peak-to-peak amplitude in divisions. One large division corresponds to 2% hum modulation.



VSM-5B SCALE READING IN dBmV
CONVERTED TO VOLTAGE AT VSM-5B
INPUT FOR FIELD INTENSITY MEASUREMENTS

FIGURE 23

46 6212
K•E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.



ANTENNA GAIN IN dB
vs GAIN FACTOR (G)

FIGURE 24

46 6212
SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

dBmV	V uV
-60	1.00
-59	1.12
-58	1.26
-57	1.41
-56	1.59
-55	1.78
-54	2.00
-53	2.24
-52	2.51
-51	2.82
-50	3.16
-49	3.55
-48	3.98
-47	4.47
-46	5.01
-45	5.62
-44	6.31
-43	7.08
-42	7.94
-41	8.91
-40	10.00

dBmV	V uV
-40	10.0
-39	11.2
-38	12.6
-37	14.1
-36	15.9
-35	17.8
-34	20.0
-33	22.4
-32	25.1
-31	28.2
-30	31.6
-29	35.5
-28	39.8
-27	44.7
-26	50.1
-25	56.2
-24	63.1
-23	70.8
-22	79.4
-21	89.1
-20	100.0

dBmV	V uV
-20	100
-19	112
-18	126
-17	141
-16	159
-15	178
-14	200
-13	224
-12	251
-11	282
-10	316
- 9	355
- 8	398
- 7	447
- 6	501
- 5	562
- 4	631
- 3	708
- 2	794
- 1	891
- 0	1000

TABLE #3

VSM-5B SCALE READING dBmV	VSM-5B INPUT VOLTAGE
-40	10 uV
-30	31.6 uV
-20	100 uV
-10	316 uV
0	1 mV
+10	3.16 mV
+20	10 mV
+30	31.6 mV
+40	100 mV

TABLE #4

CONVERSION FACTORS FOR FILED INTENSITY SURVEYS

CHANNEL	FACTOR (C)	CHANNEL	FACTOR (C)
2	1.20	8	3.84
3	1.32	9	3.97
4	1.45	10	4.10
5	1.66	11	4.22
6	1.79	12	4.35
7	3.72	13	4.47

TABLE #5

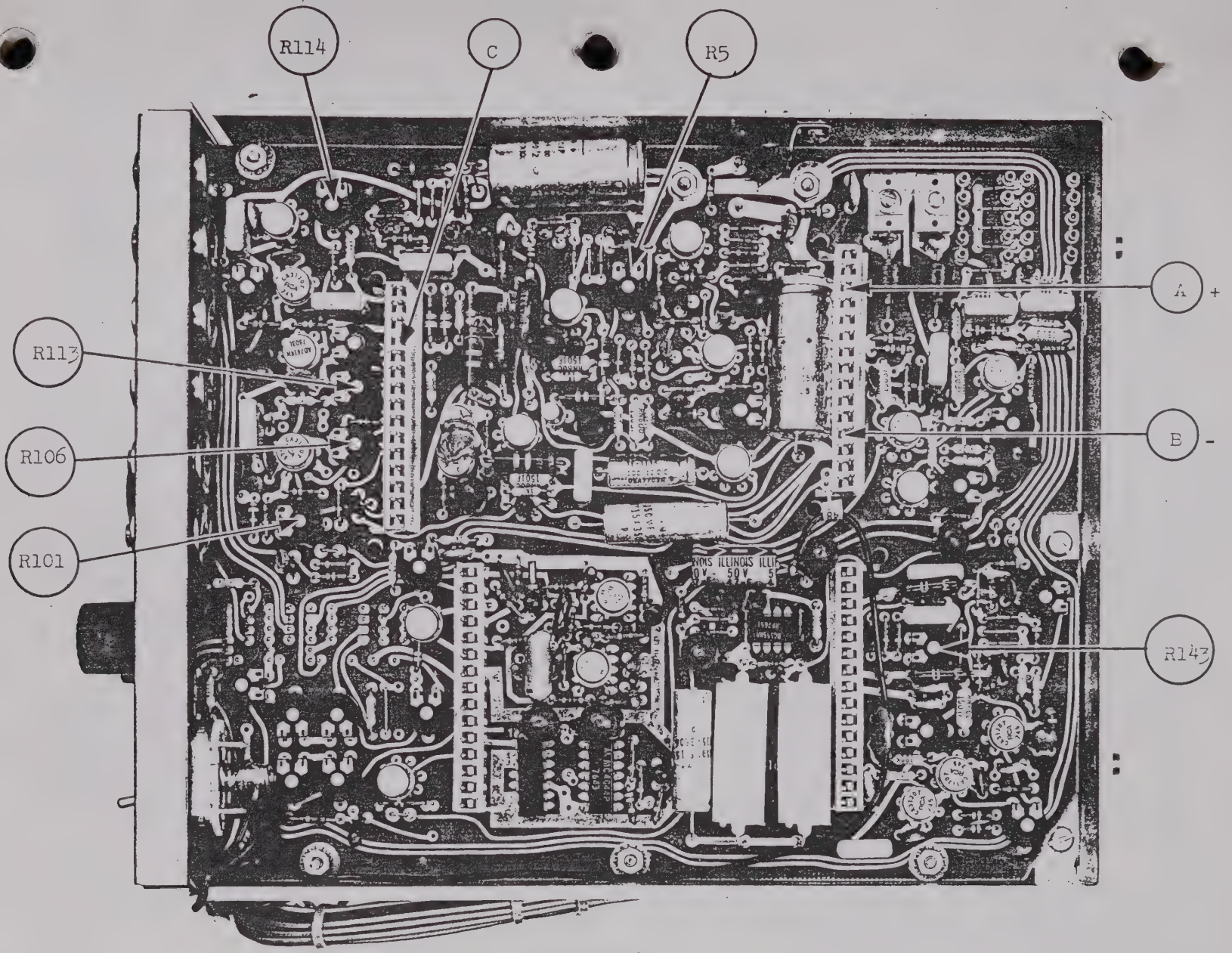


FIGURE 26.

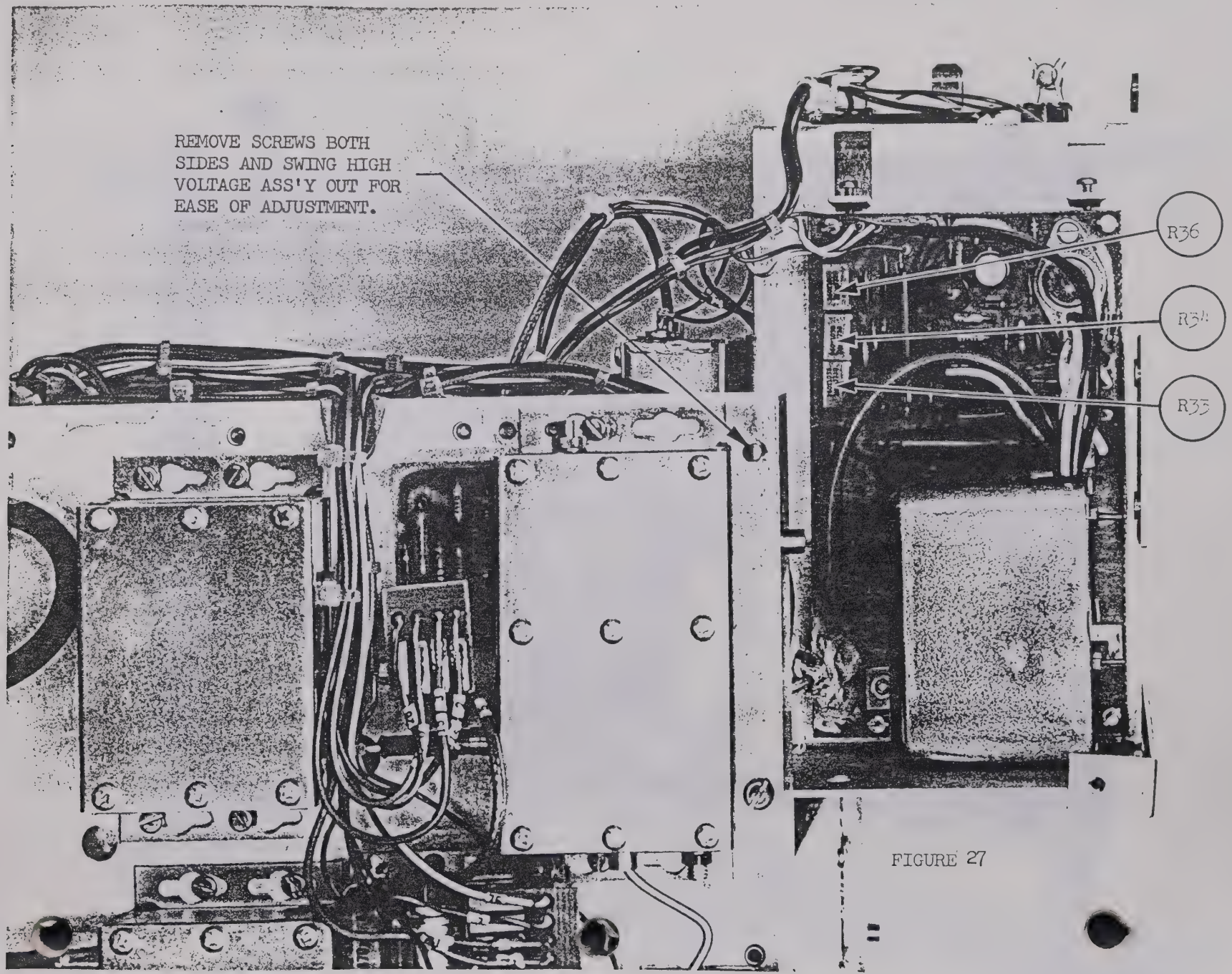

REMOVE SCREWS BOTH SIDES AND SWING HIGH VOLTAGE ASS'Y OUT FOR EASE OF ADJUSTMENT.
R36
R34
R35

FIGURE 27

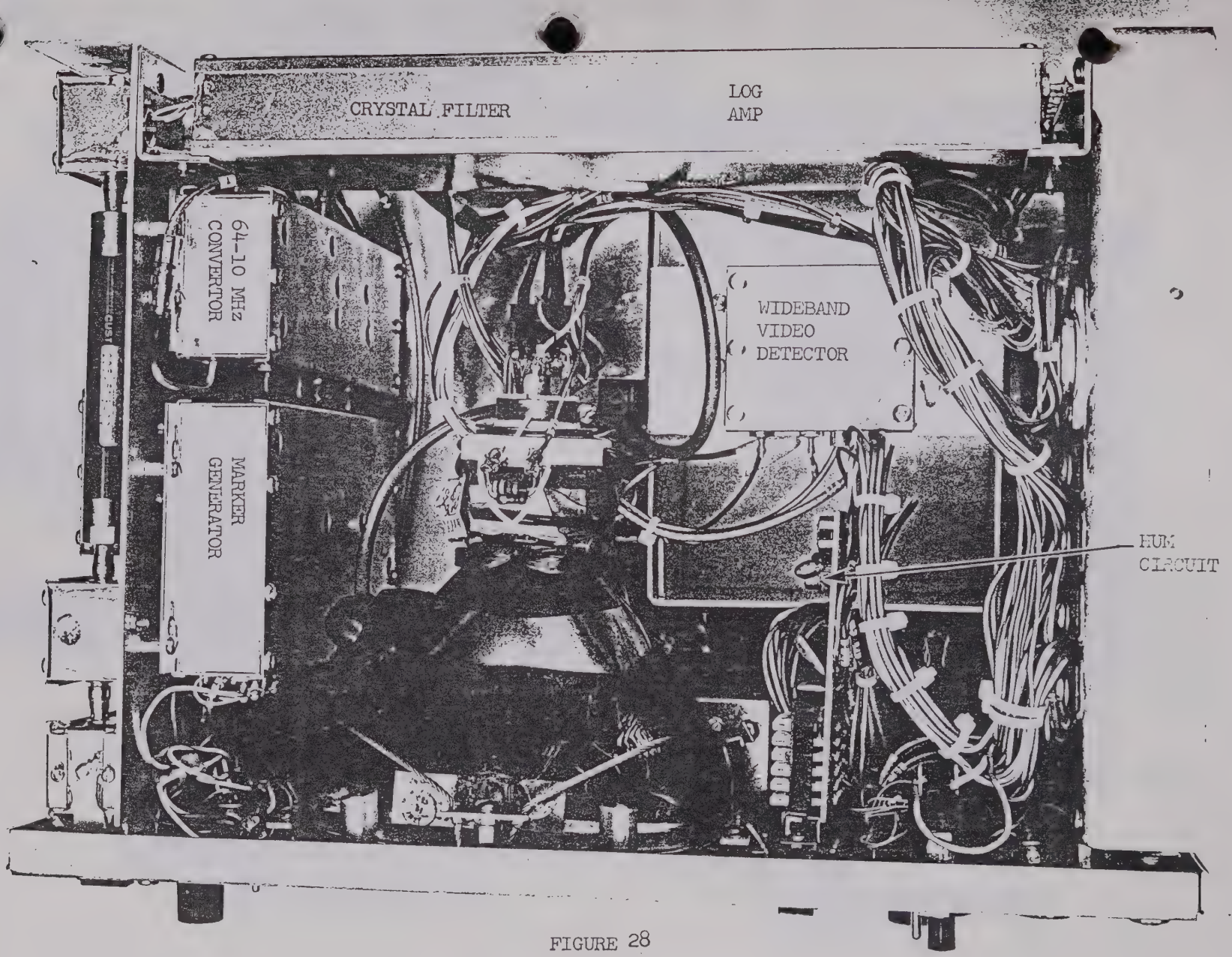

CRYSTAL FILTER
LOG
AMP
64-10 MHz
CONVERTOR
WIDEBAND
VIDEO
DETECTOR
MARKER
GENERATOR
HUM
CIRCUIT

FIGURE 28

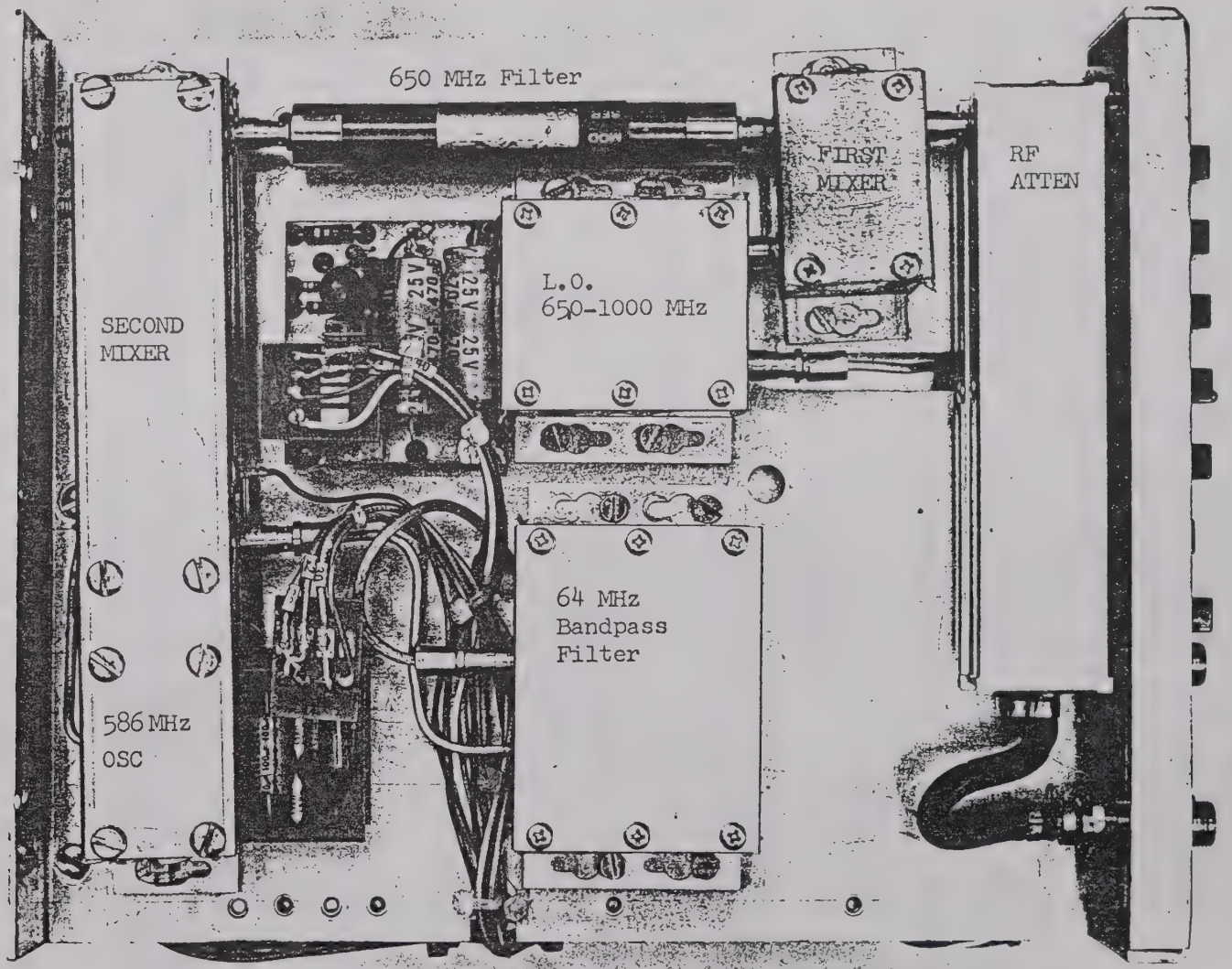

650 MHz Filter
FIRST
MIXER
RF
ATTEN
L.O.
650-1000 MHz
SECOND
MIXER
64 MHz
Bandpass
Filter
586 MHz
OSC

FIGURE 29

SECTION 5

ALIGNMENT

5.1 INTRODUCTION

The VSM-5B is properly aligned at the factory, and only minor adjustments should be necessary due to aging or changing of components. The following paragraphs describe those adjustments which may be conventiently performed in the field.

5.2 EQUIPMENT REQUIRED

12 to 15 volts DC, 1.5 AMP capability. Digital voltmeter or VTVM. High voltage probe for voltmeter capable of 5 KV. Oscilloscope, Tektronic 545 or equivalent. Frequency counter to 1000 Hz.

5.3 LOW VOLTAGE POWER SUPPLY ADJUSTMENT (see Figure 26)

5.3.1 Apply a 12 to 15 volt DC power source to the EXT BATT connector.

5.3.2 Turn on the VSM-5B.

5.3.3 Attach a DVM between points A and B (see Figure 6). Positive lead to point A.

5.3.4 Adjust R5 for +11.3 volts ±.1 volt.

5.3.5 Adjust the VERT control to position the baseline trace on the CAL line of the graticule. Be sure RESOLUTION is in 200 KHz position.

5.3.6 Reduce the input voltage to 11.5 ±.05 volts.

5.3.7 Depress the BATT CHECK switch.

5.3.8 The horizontal trace should deflect to the center of the graticule (BATT level).

5.3.9 Adjust R143, the BATT LEVEL pot, to center the trace at the BATT LEV line on the CRT graticule.

5.4 RATE GENERATOR ADJUSTMENT (see Figure 26)

5.4.1 Set the VSM-5B for normal operation.

5.4.2 Attach the oscilloscope between points C and point B-ground.

5.4.3 Set the oscilloscope to DC coupling, and select 5 volt scale.

5.4.4 Adjust R101, the OFFSET pot, for a triangular waveform centered around +5.7 volts.

5.4.5 Adjust R106, the ramp amplifier pot, for a maximum peak-to-peak voltage of 2.5 volts. See Fiugre 25.

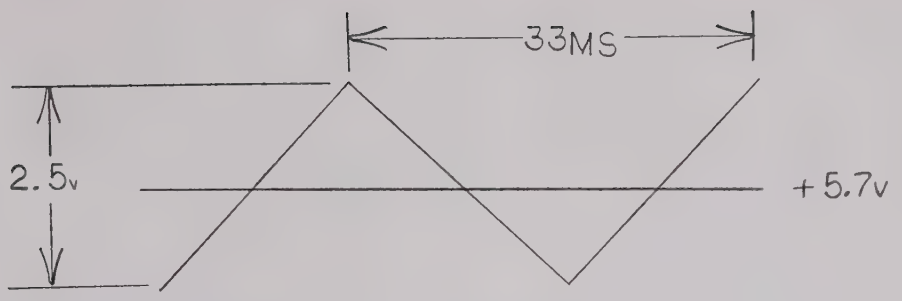


FIGURE 25

5.4.6 Adjust R113, rate time, for a one Hz span of 33 ms. Note that the RATE/MAN control (front panel) should be fully CW. Set the RETRACE BLKG switch to ON (up).

5.5 HORIZONTAL GAIN ADJUSTMENT (see Figure 26)

5.5.1 Set the VSM-5B for normal operation.

5.5.2 Adjust R114, the horizontal gain pot, for a horizontal deflection of 10 cm.

5.5.3 Adjust R202, HORIZ on the front panel, to recenter the horizontal trace on the graticule.

5.6 VERTICAL GAIN ADJUSTMENT

5.6.1 See paragraph 3.3.8 for vertical gain adjustments.

5.7 HIGH VOLTAGE POWER SUPPLY (see Figure 27)

5.7.1 Turn OFF VSM-5B.

5.7.2 Connect a high voltage probe between the anode head (+) of the CRT and ground (-). Leave the load connected to the CRT for this adjustment.

5.7.3 Turn ON the VSM-5B and allow about 15 seconds warm-up time.

5.7.4 Set the INTENSITY control on the front panel to mid-range.

5.7.5 Adjust the high voltage pot, R33, for a reading of 3750V (3.75 KV).

5.7.6 Increase the INTENSITY control (FP) to maximum. Observe the horizontal trace. No blooming of the trace should occur, as the INTENSITY control is varied throughout its range. If blooming is observed, decrease the high voltage level until the blooming disappears.

5.7.7 Turn OFF the VSM-5B before removing the high voltage probe.

5.8 FOCUS ADJUSTMENT (see Figure 27)

5.8.1 Set the VSM-5B for normal operation.

5.8.2 Adjust the focus control, R36, for the clearest possible trace.

5.9 INTENSITY ADJUSTMENT (see Figure 27)

5.9.1 Turn OFF the VSM-5B.

5.9.2 Disconnect the high voltage (HV) lead from the CRT high-voltage(Ultor).

5.9.3 Turn ON the VSM-5B.

5.9.4 Adjust the intensity limit pot, R34, for a maximum beam current of 25 uA. Turn OFF power and reconnect RV lead to the Ultor terminal.

5.10 MISCELLANEOUS

See Figure 28 and Figure 29 for location of carious sub-assemblies. These circuits should not require any alignment in the field. They are presented here for reference only.

SECTION 6

DOCUMENTATION

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Sub-Assemblies

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A205-582-00 CHARGER/CONVERTER

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
F901	034-008	Fuse, 1 AMP SLO-BLO
IC901	076-038	Integrated Circuit, 7812
IC902	076-038	Integrated Circuit, 7812
LED901	025-140	Diode, LED
S901	057-147	Switch, 115/230v
S902	057-217	Switch, Slide
T901	061-065	Transformer, Power

A205-595-02 FINAL SUB-ASSEMBLY

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
F1	034-017	Fuse, 10A
F2	034-009	Fuse, 1/2A SLO-BLO
V201	063-017-02	CRT TUBE

A205-535 HIGH VOLTAGE P.C.B.

C15	012-407	Capacitor, .1 uf/35v
C16	012-302	Capacitor, 150 uf/15v
C17	012-069	Capacitor, .0015 uf
C18	012-276	Capacitor, 10 uf/25v
C19	012-276	Capacitor, 10 uf/25v
C20	012-050	Capacitor, .01 uf
C21	012-066	Capacitor, .01 uf DURA
C22	012-302	Capacitor, 150 uf/15v
C23	012-437	Capacitor, .1 uf
C24	012-413	Capacitor, 1000 pf/9kv
C25	012-050	Capacitor, .01 uf
C26	012-085	Capacitor, .005 uf
C27	012-050	Capacitor, .01 uf
C28	012-085	Capacitor, .005 uf
CR6	025-044	Diode, 1N4006
CR7	025-084	Diode, 1N914-
CR8	025-084	Diode, 1N914
CR9	025-084	Diode, 1N914
CR10	025-084	Diode, 1N914
CR11	025-044	Diode, 1N4006
CR12	025-044	Diode, 1N4006
IC5	076-042	Integrated Circuit, NE555
IC6	076-002	Integrated Circuit, 741C
L1	035-061	Inductor, 100 uh, 2 AMP
L2	035-041	Inductor, 100 uh
L4	035-061	Inductor, 100 uh, 2 AMP
Q11	062-003	Transistor, 2N3567
Q12	062-080	Transistor, 2N3583
Q13	062-002	Transistor, 2N3565
R20	047-675	Resistor, 24.3K, 1/4w, 1%
R21	047-462	Resistor, 1K, 1/4w, 1%
R22	045-668	Resistor, 100 ohm, 1/4w, 10%
R23	045-710	Resistor, 1K, 1/4w, 10%
R24	047-658	Resistor, 5K, 1/4w, 1%
R25	045-668	Resistor, 100 ohm, 1/4w, 10%
R26	045-075	Resistor, 150 ohm, 1/4w, 10%
R27	045-615	Resistor, 5.6 ohm, 1/4w, 10%
R28	045-724	Resistor, 2.2K, 1/4w, 10%
R29	045-710	Resistor, 1K, 1/4w, 10%
R30	047-449	Resistor, 2K, 1/4w, 1%
R31	047-449	Resistor, 2K, 1/4w, 1%
R32	047-567	Resistor, 390 MEG, 2w, 1%

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R33	048-246	Resistor, 1 MEG, Variable
R34	048-246	Resistor, 1 MEG, Variable
R35	045-752	Resistor, 10K, 1/4w, 10%
R36	048-246	Resistor, 1 MEG, Variable
R37	045-794	Resistor, 100K, 1/4w, 10%
R39	046-212	Resistor, 270K, 1/2w, 10%
T201	204-721	Flyback, XFMR

A205-509 CRYSTAL FILTER & LOG AMP

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C701	012-001	Capacitor, 1000 pf F.T.
C715	012-001	Capacitor, 1000 pf F.T.
C734	012-141	Capacitor, 10 pf F.T.
C735	012-141	Capacitor, 10 pf F.T.
C736	012-141	Capacitor, 10 pf F.T.
C737	012-260	Capacitor, 330 uf/6v
C738	012-141	Capacitor, 10 pf F.T.
C739	012-141	Capacitor, 10 pf F.T.
C852	012-001	Capacitor, 1000 pf F.T.
C853	012-001	Capacitor, 1000 pf F.T.

A205-537 LOG AMP P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C702	012-411	Capacitor, .01 uf
C703	012-009	Capacitor, 1000 pf
C704	012-050	Capacitor, .01 uf
C705	012-050	Capacitor, .01 uf
C706	012-009	Capacitor, 1000 pf
C707	015-045	Capacitor, 110-450 pf Variable
C708	012-009	Capacitor, 1000 pf
C709	012-138	Capacitor, 1000 pf DURA
C710	012-009	Capacitor, 1000 pf
C711	012-411	Capacitor, .01 uf
C712	012-411	Capacitor, .01 uf
C713	012-411	Capacitor, .01 uf
C714	012-411	Capacitor, .01 uf
C716	012-009	Capacitor, 1000 pf
C717	012-009	Capacitor, 1000 pf
C718	012-269	Capacitor, .1 uf
C719	012-411	Capacitor, .01 uf
C720	012-009	Capacitor, 1000 pf
C721	012-009	Capacitor, 1000 pf
C722	012-009	Capacitor, 1000 pf
C723	012-009	Capacitor, 1000 pf
C724	012-411	Capacitor, .01 uf
C725	012-411	Capacitor, .01 uf
C726	012-411	Capacitor, .01 uf

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C727	012-411	Capacitor, .01 uf
C728	012-009	Capacitor, 1000 pf
C729	012-009	Capacitor, 1000 pf
C730	012-411	Capacitor, .01 uf
C731	012-009	Capacitor, 1000 pf
C732	012-009	Capacitor, 1000 pf
C733	012-411	Capacitor, .01 uf
C740	012-009	Capacitor, 1000 pf
C741	012-009	Capacitor, 1000 pf
C746	012-050	Capacitor, .01 uf
CR701	025-086	Diode, 1N4446
CR702	025-086	Diode, 1N4446
CR703	025-078	Diode, HP2800
CR704	025-078	Diode, HP2800
CR705	025-078	Diode, HP2800
CR706	025-078	Diode, HP2800
IC701	076-006	Integrated Circuit, 1550G
IC702	076-010	Integrated Circuit, 733
IC703	076-010	Integrated Circuit, 733
IC704	076-019	Integrated Circuit, TL441CN
IC705	076-010	Integrated Circuit, 733
IC706	076-010	Integrated Circuit, 733
L701	035-041	Inductor, 100 uh
L702	035-041	Inductor, 100 uh
L703	035-001	Inductor, 1 uh
L704	035-041	Inductor, 100 uh
L705	035-041	Inductor, 100 uh
L706	035-041	Inductor, 100 uh
L708	035-041	Inductor, 100 uh
L709	035-041	Inductor, 100 uh
L710	035-041	Inductor, 100 uh
L711	035-041	Inductor, 100 uh
L712	035-041	Inductor, 100 uh
L713	035-041	Inductor, 100 uh
L714	035-041	Inductor, 100 uh
L715	035-041	Inductor, 100 uh
L717	035-041	Inductor, 100 uh
L718	035-041	Inductor, 100 uh
Q701	062-001	Transistor, 2N3564
Q702	062-001	Transistor, 2N3564
R701	045-752	Resistor, 10K, 1/4w, 10%
R702	048-157	Resistor, 10K Variable
R703	048-157	Resistor, 10K Variable
R704	048-173	Resistor, 200 ohm Variable
R705	045-656	Resistor, 51 ohm, 1/4w, 5%
R706	045-656	Resistor, 51 ohm, 1/4w, 5%
R708	045-656	Resistor, 51 ohm, 1/4w, 5%
R709	045-656	Resistor, 51 ohm, 1/4w, 5%
R710	047-462	Resistor, 1K, 1/4w, 1%
R711	048-173	Resistor, 10K, Variable
R712	048-157	Resistor, 10K Variable

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R713	048-157	Resistor, 10K Variable
R714	048-157	Resistor, 10K Variable
R715	048-157	Resistor, 10K Variable
R716	045-710	Resistor, 1K, 1/4w, 10%
R717	045-710	Resistor, 1K, 1/4w, 10%
R718	045-752	Resistor, 10K, 1/4w, 10%
R719	048-157	Resistor, 10K Variable
R720	045-710	Resistor, 1K, 1/4w, 10%
R721	045-710	Resistor, 1K, 1/4w, 10%
R722	045-752	Resistor, 10K, 1/4w, 10%
R723	048-157	Resistor, 10K Variable
R724	048-157	Resistor, 10K Variable
R725	048-157	Resistor, 10K Variable
R730	045-710	Resistor, 1K, 1/4w, 10%
R731	045-710	Resistor, 1K, 1/4w, 10%

A205-538 CRYSTAL FILTER P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C839	012-009	Capacitor, 1000 pf
C841	012-009	Capacitor, 1000 pf
C843	012-009	Capacitor, 1000 pf
C844	012-009	Capacitor, 1000 pf
C845	012-050	Capacitor, .01 uf
C846	012-050	Capacitor, .01 uf
C847	012-050	Capacitor, .01 uf
C848	012-050	Capacitor, .01 uf
C849	012-050	Capacitor, .01 uf
C855	012-134	Capacitor, .05 uf
C857	012-009	Capacitor, 1000 pf
C858	012-009	Capacitor, 1000 pf
C859	012-050	Capacitor, .01 uf
C860	012-009	Capacitor, 1000 pf
C861	012-009	Capacitor, 1000 pf
C862	012-268	Capacitor, .1 uf
CR801	025-012	Diode, 1N277
CR802	025-012	Diode, 1N277
CR803	025-012	Diode, 1N277
CR804	025-012	Diode, 1N277
CR805	025-012	Diode, 1N277
CR806	025-012	Diode, 1N277
CR807	025-012	Diode, 1N277
CR808	025-012	Diode, 1N277
CR809	025-012	Diode, 1N277
L823	035-041	Inductor, 100 uh
L827	035-041	Inductor, 100 uh
L828	035-041	Inductor, 100 uh
L829	035-041	Inductor, 100 uh
L830	035-041	Inductor, 100 uh
L831	035-041	Inductor, 100 uh
L832	035-041	Inductor, 100 uh
L833	035-041	Inductor, 100 uh
L834	035-041	Inductor, 100 uh
L835	035-041	Inductor, 100 uh

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
L836	035-041	Inductor, 100 uh
L837	035-041	Inductor, 100 uh
R816	045-735	Resistor, 3.9K, 1/4w, 10%
R817	045-675	Resistor, 150 ohm, 1/4w, 10%
R820	045-735	Resistor, 3.9K, 1/4w, 10%
R821	045-696	Resistor, 470 ohm, 1/4w, 10%
R822	045-735	Resistor, 3.9K, 1/4w, 10%
R823	048-250	Resistor, 1K Variable
R824	045-735	Resistor, 3.9K, 1/4w, 10%
R825	045-735	Resistor, 3.9K, 1/4w, 10%
R826	045-735	Resistor, 3.9K, 1/4w, 10%
R827	045-710	Resistor, 1K, 1/4w, 10%
R828	045-675	Resistor, 150 ohm, 1/4w, 10%
R829	045-735	Resistor, 3.9K, 1/4w, 10%
R830	045-735	Resistor, 3.9K, 1/4w, 10%
R831	045-710	Resistor, 1K, 1/4w, 10%
R832	045-999	FACTORY SELECTED VALUE
Z802	071-055-00	Crystal, 10 kHz
A803	071-017	Crystal, .5 kHz

A205-523 64 MHz FILTER P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C641	015-009	Capacitor, 4-40 pf Variable
C642	012-035	Capacitor, 50 pf
C643	012-012	Capacitor, .56 pf MUD
C644	015-008	Capacitor, 4-40 pf Variable
C645	012-012	Capacitor, .56 pf MUD
C646	015-008	Capacitor, 4-40 pf Variable
C647	012-035	Capacitor, 50 pf
C648	015-008	Capacitor, 4-40 pf Variable
L641	035-012	Inductor, .68 uh
L642	035-012	Inductor, .68 uh
L643	035-012	Inductor, .68 uh
L644	035-012	Inductor, .68 uh

A205-524 64-10 MHz CONVERTER

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C818	012-273	Capacitor, 2.2 uf/35v
C824	012-001	Capacitor, 1000 pf F.T.
C825	012-001	Capacitor, 1000 pf F.T.
C827	012-001	Capacitor, 1000 pf F.T.
C831	012-001	Capacitor, 1000 pf F.T.
C833	012-273	Capacitor, 2.2 uf/35v
J802	020-329	Connector, SMA
J803	020-329	Connector, SMA

A205-525 64-10 MHz P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C801	015-009	Capacitor, 8-60 pf Variable
C802	012-009	Capacitor, 1000 pf
C803	012-009	Capacitor, 1000 pf
C804	012-009	Capacitor, 1000 pf
C805	012-009	Capacitor, 1000 pf
C806	012-009	Capacitor, 1000 pf
C807	012-114	Capacitor, .02 uf
C808	012-009	Capacitor, 1000 pf
C809	015-009	Capacitor, 8-60 pf Variable
C810	012-403	Capacitor, 110 pf DURA
C811	012-050	Capacitor, .01 uf
C812	012-230	Capacitor, 68 pf DURA
C813	012-009	Capacitor, 1000 pf
C814	012-117	Capacitor, 33 pf DURA
C815	012-050	Capacitor, .01 uf
C816	012-009	Capacitor, 1000 pf
C817	012-009	Capacitor, 1000 pf
C819	012-009	Capacitor, 1000 pf
C821	012-230	Capacitor, 68 pf DURA
C822	012-095	Capacitor, 330 pf DURA
C823	012-401	Capacitor, 680 pf DURA
C828	012-035	Capacitor, .56 pf MUD
C829	012-009	Capacitor, 1000 pf
C830	012-297	Capacitor, 150 pf DURA
C832	012-273	Capacitor, 2.2 uf/35v
IC801	076-006	Integrated Circuit, 1550G
L801	035-045	Inductor, .39 uh
L802	035-010	Inductor, 6.8 uh
L803	035-010	Inductor, 6.8 uh
L804	035-156-01	Inductor, 6-1/2T
L805	035-010	Inductor, 6.8 uh
L806	035-024	Inductor, .22 uh
L808	036-004-01	Inductor, Variable
L809	036-004-06	Inductor, Variable
L810	035-041	Inductor, 100 uh
L811	035-041	Inductor, 100 uh
L812	035-041	Inductor, 100 uh
Q801	062-001	Transistor, 2N3564
Q802	062-093	Transistor, S1140
Q803	062-154	ransistor, LT2001
R801	045-736	Resistor, 4.3K, 1/4w, 5%
R802	045-752	Resistor, 10K, 1/4w, 10%
R803	045-689	Resistor, 330 ohm, 1/4w, 10%
R804	045-654	Resistor, 47 ohm, 1/4w, 10%
R805	045-668	Resistor, 100 ohm, 1/4w, 10%
R806	047-537	Resistor, 182K, 1/4w, 1%
R808	045-654	Resistor, 47 ohm, 1/4w, 10%
R809	045-654	Resistor, 47 ohm, 1/4w, 10%
R810	045-733	Resistor, 3.6K, 1/4w, 10%
R811	045-654	Resistor, 47 ohm, 1/4w, 10%
R812	048-250	Resistor, 1K Variable

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R813	047-123	Resistor, 75 ohm, 1/4w, 10%
R815	045-668	Resistor, 100 ohm, 1/4w, 10%
R818	045-684	Resistor, 240 ohm, 1/4w, 5%
R819	045-654	Resistor, 47 ohm, 1/4w, 10%
R828	045-640	Resistor, 22 ohm, 1/4w, 10%
R833	045-689	Resistor, 330 ohm, 1/4w, 10%
R834	045-731	Resistor, 3.3K, 1/4w, 10%
R835	045-731	Resistor, 3.3K, 1/4w, 10%
R836	045-703	Resistor, 680 ohm, 1/4w, 10%
Y801	023-015-00	Crystal, 54 MHz
Z801	238-004	Double Balance Mixer

A205-547 FIRST MIXER

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C630	015-013	Capacitor, .8-8.5 pf Variable
J602	020-329	Connector
J603	020-329	Connector
J604	020-329	Connector
R630	045-675	Resistor, 150 ohm, 1/4w, 10%
R631	045-647	Resistor, 33 ohm, 1/4w, 10%
R632	045-675	Resistor, 150 ohm, 1/4w, 10%
R634	045-615	Resistor, 5.6 ohm, 1/4w, 5%
Z601	238-002	Double Balance Mixer

A205-550 SECOND MIXER CHASSIS

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C601	015-004	Capacitor, .8-12 pf Variable
C602	015-013	Capacitor, .8-8.5 pf Variable
C611	012-001	Capacitor, 1000 pf F.T.
C554	015-013	Capaciotr, .8-8.5 pf Variable
J607	020-329	Connector, SMA
P606	020-331	Connector, SMA

A205-551 586 MHz RF PLATE

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C551	012-555-01	Capacitor, 5 pf
C552	012-227	Capacitor, 220 pf
C553	012-089	Capacitor, 2 pf MUD
C555	012-219	Capacitor, 500 pf Solder-in
C556	012-001	Capacitor, 1000 pf F.T.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C557	012-001	Capacitor, 1000 pf F.T.
C558	012-001	Capacitor, 1000 pf F.T.
CR551	064-025	Varactor, MV3140
L551	035-024	Inductor, .22 uh
L552	035-024	Inductor, .22 uh
L554	035-024	Inductor, .22 uh
Q551	062-086	Transistor, 2N5160
R551	046-040	Resistor, 22 ohm, 1/2w, 10%
R552	045-668	Resistor, 100 ohm, 1/4w, 10%
R553	045-368	Resistor, 100 ohm, 1/8w, 10%
R554	045-731	Resistor, 3.3K, 1/4w, 10%

A205-552 586 MHz DC P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C559	012-060	Capacitor, 100 uf/16v
C560	012-273	Capacitor, 2.2 uf/35v
J502	044-039	Plug, 4 pin male
L553	019-009	Conductor, #22 BUSS
R555	045-640	Resistor, 22 ohm, 1/4w, 10%
R556	047-503	Resistor, 498 ohm, 1/4w, 1%
R557	047-503	Resistor, 498 ohm, 1/4w, 1%
R558	047-359	Resistor, 3320 ohm, 1/2w, 1%
R559	047-534	Resistor, 100K, 1/4w, 1%

A205-593 SECOND MIXER P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C603	012-247	Capacitor, 10 pf Solder-in
C604	012-416	Capacitor, 68 pf
C605	012-009	Capacitor, 1000 pf
C606	015-009	Capacitor, 8-60 pf Variable
C607	015-009	Capacitor, 8-60 pf Variable
C608	012-416	Capacitor, 68 pf
C609	012-009	Capacitor, 1000 pf
C610	012-009	Capacitor, 1000 pf
L601	019-163	Conductor, Gold Strap
L602	019-109	Conductor, 9-1/2T
L603	035-010	Inductor, 6.8 uh
Q601	062-158	Transistor, NE57835
R601	045-703	Resistor, 680 ohm, 1/4w, 10%
R602	045-738	Resistor, 4.7K, 1/4w, 10%

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R603	045-694	Resistor, 430 ohm, 1/4w, 5%
R604	045-656	Resistor, 51 ohm, 1/4w, 5%
R605	045-656	Resistor, 51 ohm, 1/4w, 5%
R606	045-668	Resistor, 100 ohm, 1/4w, 10%
Z603	238-002	Double Balance Mixer

A205-553-02 MARKER GENERATOR

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C304	012-001	Capacitor, 1000 pf F.T.
C305	012-001	Capacitor, 1000 pf F.T.
C315	012-001	Capacitor, 1000 pf F.T.
C334	012-001	Capacitor, 1000 pf F.T.
C335	012-141	Capacitor, 10 pf F.T.
C349	012-141	Capacitor, 10 pf F.T.
C350	012-001	Capacitor, 1000 pf F.T.
C351	012-132	Capacitor, .1 uf
C352	012-291	Capacitor, 1 uf

A205-544-02 MARKER GENERATOR P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C301	012-009	Capacitor, 1000 pf DISC
C302	012-050	Capacitor, .01 uf DISC
C303	012-290	Capacitor, 82 pf DURA
C306	015-007	Capacitor, 1.5-20 pf Variable
C307	012-050	Capacitor, .01 uf DISC
C308	012-050	Capacitor, .01 uf DISC
C309	012-021	Capacitor, 470 pf DURA
C310	015-009	Capacitor, 8-60 pf Variable
C311	012-012	Capacitor, 50 pf DISC
C312	012-050	Capacitor, .01uf DISC
C313	012-150	Capacitor, .20 pf
C314	012-050	Capacitor, .01 uf DISC
C316	012-050	Capacitor, .01 uf DISC
C317	012-009	Capacitor, 1000 pf DISC
C318	012-050	Capacitor, .01 uf DISC
C319	015-007	Capacitor, 1.5-20 pf Variable
C320	012-009	Capacitor, 1000 pf DISC
C321	015-007	Capacitor, 1.5-20 pf Variable
C322	012-157	Capacitor, 1.0 pf MUD
C323	012-050	Capacitor, .01 uf DISC
C324	012-050	Capacitor, .01 uf DISC
C325	015-045	Capacitor, 110-540 pf Variable
C326	012-156	Capacitor, .47 pf MUD
C327	012-050	Capacitor, .01 uf DISC
C328	012-050	Capacitor, .01 uf DISC
C329	012-273	Capacitor, 2.2 uf/35v
C331	012-156	Capacitor, .47 pf MUD
C332	012-050	Capacitor, .01 uf DISC

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C333	012-021	Capacitor, 470 pf DURA
C338	012-091	Capacitor, 33 pf MUD
C339	012-009	Capacitor, 1000 pf DISC
C340	012-117	Capacitor, 33 pf MICA
C341	012-117	Capacitor, 33 pf MICA
C342	012-117	Capacitor, 33 pf MICA
C343	012-038	Capacitor, 470 pf 1/2F.T.
C345	012-247	Capacitor, 10 pf Solder-in
C346	012-291	Capacitor, .1 uf/35v
C348	012-276	Capacitor, 10 uf/25v
C353	012-091	Capacitor, 3.3 pf MUD
C354	012-276	Capacitor, 10 uf/25v
CR301	025-110	Diode, HP5082-0180
CR302	025-110	Diode, HP5082-0180
CR303	025-110	Diode, HP5082-0180
IC301	076-016	Integrated Circuit, SN7490N
L301	035-041	Inductor, 100 uh
L302	035-156-00	Inductor, 16T
L303	035-041	Inductor, 100 uh
L304	035-013	Inductor, 10 uh
L305	035-041	Inductor, 100 uh
L306	035-041	Inductor, 100 uh
L307	035-041	Inductor, 100 uh
L308	035-156-00	Inductor, 16T
L310	035-010	Inductor, 6.8 uh
L311	035-150-00	Inductor, 16T
L312	035-024	Inductor, .22 uh
L313	035-041	Inductor, 100 uh
L314	035-041	Inductor, 100 uh
L315	035-001	Inductor, 1 uh
L316	035-041	Inductor, 100 uh
L317	035-041	Inductor, 100 uh
L318	035-041	Inducotr, 100 uh
L319	035-041	Inductor, 100 uh
L320	035-041	Inducotr, 100 uh
L321	035-024	Inductor, .22 uh
L322	035-041	Inductor, 100 uh
L324	035-041	Inductor, 100 uh
L326	035-000	FACTORY SELECTED VALUE
Q301	062-093	Transistor, S1140
Q302	062-093	Transistor, S1140
Q303	062-093	Transistor, S1140
Q304	062-093	Transistor, S1140
Q305	062-093	Transistor, S1140
Q306	062-093	Transistor, S1140
Q307	062-002	Transistor, 2N3565
R301	045-742	Resistor, 5.6K, 1/4w, 10%
R302	045-742	Resistor, 5.6K, 1/4w, 10%
R303	046-089	Resistor, 330 ohm, 1/2w, 10%
R304	045-742	Resistor, 5.6K, 1/4w, 10%
R305	045-742	Resistor, 5.6K, 1/4w, 10%

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R306	045-710	Resistor, 1K, 1/4w, 10%
R307	045-766	Resistor, 22K, 1/4w, 10%
R308	046-082	Resistor, 220 ohm, 1/2w, 10%
R309	045-724	Resistor, 2.2k, 1/4w, 10%
R310	045-625	Resistor, 10 ohm, 1/4w, 5%
R311	046-082	Resistor, 220 ohm, 1/2w, 10%
R312	045-654	Resistor, 47 ohm, 1/4w, 10%
R313	045-654	Resistor, 47 ohm, 1/4w, 10%
R315	045-656	Resistor, 51 ohm, 1/4w, 10%
R316	045-656	Resistor, 51 ohm, 1/4w, 10%
R318	045-752	Resistor, 10K, 1/4w, 10%
R319	045-625	Resistor, 10 ohm, 1/4w, 5%
R321	045-689	Resistor, 330 ohm, 1/4w, 10%
R322	045-662	Resistor, 68 ohm, 1/4w, 5%
R323	045-675	Resistor, 150 ohm, 1/4w, 10%
R324	045-662	Resistor, 68 ohm, 1/4w, 5%
R326	045-654	Resistor, 47 ohm, 1/4w, 10%
R328	045-791	Resistor, 82K, 1/4w, 10%
R329	045-791	Resistor, 82K, 1/4w, 10%
R330	045-710	Resistor, 1K, 1/4w, 10%
R331	045-689	Resistor, 330 ohm, 1/4w, 10%
X301	023-005	Crystal, 10 MHz
X301	238-002	Double Balance Mixer

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A205-557 LOCAL OSCILLATOR RF P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C501	012-192	Capacitor, 1.2 pf MUD
C502	012-217	Capacitor, 1000 pf Solder-in
C503	012-217	Capacitor, 1000 pf Solder-in
C504	012-192	Capacitor, 1.2 pf MUD
C505	071-051	Filter, 3000 pf F.T.
C509	071-051	Filter, 3000 pf F.T.
C510	071-051	Filter, 3000 pf F.T.
CV501	064-025	Varactor, MV3140
CV502	064-025	Varactor, MV3140
L501	035-024	Inductor, .22 uh
L502	035-024	Inductor, .22 uh
L503	035-024	Inductor, .22 uh
L504	035-074	Inductor, .33 uh
L505	035-004	Inductor, .68 uh
L506	035-074	Inductor, .33 uh
L507	035-024	Inductor, .22 uh
L508	035-024	Inductor, .22 uh
Q501	062-016	Transistor, 2N3866
Q502	062-016	Transistor, 2N3866
R501	046-046-01	Resistor, 33 ohm, 1/2w, 5%
R502	045-640-01	Resistor, 22 ohm, 1/4w, 10%

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R503	045-654-01	Resistor, 47 ohm, 1/4w, 10%
R504	045-396-01	Resistor, 470 ohm, 1/4w, 10%
R505	045-654-00	Resistor, 47 ohm, 1/4w, 10%
R506	045-640-01	Resistor, 22 ohm, 1/4w, 10%
R517	045-417-01	Resistor, 1.5K, 1/8w, 10%
R518	045-417-01	Resistor, 1.5K, 1/8w, 10%

A205-970 LOCAL OSCILLATOR DC P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C506	012-276	Capacitor, 10 uf/25v
C507	012-065	Capacitor, 500 uf/25v
C508	012-302	Capacitor, 150 uf/15v
C512	012-304	Capacitor, 47 uf/20v
C513	012-548-00	Capacitor, 1000 uf/25v
C514	012-273	Capacitor, 2.2 uf/35v
C515	012-273	Capacitor, 2.2 uf/35v
J501	044-039	Plug, 4 pin male
K501	070-009	Relay, SPST
R507	046-002	Resistor, 2.7 ohm, 1/2w, 10%
R508	045-640	Resistor, 22 ohm, 1/4w, 10%
R509	045-675	Resistor, 150 ohm, 1/4w, 10%

A205-746 WIDEBAND DETECTOR P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C1001	015-007	Capacitor, 1.5-20 pf Variable
C1002	012-432	Capacitor, 20 pf DURA
C1003	012-268	Capacitor, .1 uf
C1004	012-291	Capacitor, 1 uf/35v
C1005	012-009	Capacitor, 1000 pf
C1006	012-009	Capacitor, 1000 pf
C1007	012-050	Capacitor, .01 uf
C1008	012-203	Capacitor, 150 pf
C1010	012-291	Capacitor, 1 uf/35v
LC1001	076-010	Integrated Circuit, 733
IC1002	076-033	Integrated Circuit, 300P
IC1003	076-067	Integrated Circuit, 313oT
L1001	035-080	Inductor, 10 uh
L1002	035-041	Inductor, 100 uh
L1003	035-010	Inductor, 6.8 uh
R1001	045-710	Resistor, 1K, 1/4w, 10%
R1002	045-710	Resistor, 1K, 1/4w, 10%
R1003	045-668	Resistor, 100 ohm, 1/4w, 10%
R1004	048-250	Resistor, 1K Variable
R1005	045-668	Resistor, 100 ohm, 1/4w, 10%
R1006	045-731	Resistor, 3.3K, 1/4w, 10%
R1007	045-735	Resistor, 3.9K, 1/4w, 10%

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R1008	045-747	Resistor, 7.5K, 1/2w, 10%
R1009	045-728	Resistor, 2.7K, 1/2w, 10%
R1010	045-731	Resistor, 3.3K, 1/4w, 10%
R1011	045-752	Resistor, 10K, 1/4w, 10%
R1012	048-250	Resistor, 1K Variable
R1013	045-735	Resistor, 3.9K, 1/4w, 10%
R1014	045-654	Resistor, 47 ohm, 1/4w, 10%

A205-739 FRONT PANEL PSU

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C205	012-085	Capacitor, .005 uf
C206	012-291	Capacitor, 1 uf/35v
CR202	025-033	Diode, VR7A
CR203	025-086	Diode, 1N4446
J1	204-882	Connector
J601	020-148	Connector, F
J602	020-222	Connector, F
J603	020-222	Connector, F
LED1	025-089	Diode, LED
R201A] R201B]	048-282	Resistor, 100K/500v
R202	048-210	Resistor, 10K Variable
R203	048-210	Resistor, 10K Variable
R204/S204/S208	048-203	Resistor, 10K/SPST Variable
R215	048-199	Resistor, 10K Variable
R216	048-210	Resistor, 10K Variable
R217	048-200	Resistor, 1 MEG Variable
R218	048-199	Resistor, 10K Variable
R219	048-100	Resistor, 10K Variable
R220	048-210	Resistor, 10K Variable
R231	047-464	Resistor, 9.09K, 1/4w, 1%
R232	047-512	Resistor, 909 ohm, 1/4w, 1%
R233	047-462	Resistor, 1K, 1/4w, 1%
R235	045-738	Resistor, 4.7K, 1/4w, 10%
R1112	048-199	Resistor, 10K Variable

A205-562 RESOLUTION & HUM P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C202	012-134	Capacitor, .05 uf
C203	012-144	Capacitor, .0022 uf
C250	012-273	Capacitor, 2.2 uf/35v
C251	012-276	Capacitor, 10 uf/25v
IC250	076-002	Integrated Circuit, 741C
R234	045-812	Resistor, 270K, 1/4w, 10%
R251	045-780	Resistor, 47K, 1/4w, 10%

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R252	045-705	Resistor, 750 ohm, 1/4w, 5%
R253	048-209	Resistor, 5K Variable
R254	045-710	Resistor, 1K, 1/4w, 10%
S801	057-188	Switch, 4 Pushbutton
S802	057-188	Switch, 4 Pushbutton
S803	057-188	Switch, 4 Pushbutton
S804	057-188	Switch, 4 Pushbutton

A205-563-01 CHANNEL & MAIN P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
Q1	062-009	Transistor, 2N3616
Q5	062-076	Transistor, MJE1100
Q6	062-075	Transistor, MJE1090
Q101	062-076	Transistor, MJE1100
Q102	062-075	Transistor, MJE1090
Q105	062-076	Transistor, MJE1100
Q106	062-076	Transistor, MJE1090

A205-564-01 MAIN P.C.B.

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C46	012-276	Capacitor, 10 uf/25v
C47	012-222	Capacitor, 10 uf/50v
C113	012-291	Capacitor, 1 uf/35v
C404	012-050	Capacitor, .01 uf
C420	012-143	Capacitor, 470 pf
C426	012-008	Capacitor, 25 pf
CR29	025-086	Diode, 1N4446
CR30	025-086	Diode, 1N4446
R124	045-766	Resistor, 22K, 1/4w, 10%
R160	045-756	Resistor, 12K, 1/4w, 10%
R209	047-449	Resistor, 2K, 1/4w, 10%
R210	047-024	Resistor, 221 ohm, 1/4w, 1%
R425	045-826	Resistor, 560K, 1/4w, 1%
R427	045-878	Resistor, 10 MEG, 1/4w 1%
R429	047-463	Resistor, 1 MEG, 1/4w, 1%
R430	047-452	Resistor, 15K, 1/4w, 1%
R439	047-492	Resistor, 56.2K, 1/4w, 1%
R440	047-445	Resistor, 3.92K, 1/4w, 1%
R442	047-259	Resistor, 1.24K, 1/4w, 1%
R447	047-492	Resistor, 56.2K, 1/4w, 1%
R449	047-468	Resistor, 332K, 1/4w, 1%

A205-744 MAIN P.C.B. PSU

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C2	012-404	Capacitor, 1000 uf/25v
C3	012-276	Capacitor, 10 uf/25v

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C5	012-015	Capacitor, 100 uf/12v
C6	012-267	Capacitor, .047 uf
C7	012-113	Capacitor, .047 uf
C8	012-276	Capacitor, 10 uf/25v
C9	012-404	Capacitor, 1000 uf/25v
C10	012-085	Capacitor, .005 uf
C11	012-260	Capacitor, 330 uf/6v
C28	012-276	Capacitor, 10 uf/25v
C29	012-416	Capacitor, 68 pf
C30	012-276	Capacitor, 10 uf/25v
C35	012-276	Capacitor, 10 uf/25v
C36	012-269	Capacitor, 330 uf/6v
C37	012-110	Capacitor, 150 uf/35v
C38	012-270	Capacitor, .22 uf/35v
C39	012-270	Capacitor, .22 uf/35v
C40	012-138	Capacitor, 1000 pf DURA
C41	012-110	Capacitor, 150 uf/35v
C42	012-276	Capacitor, 10 uf/25v
C43	012-220	Capacitor, 50 uf/50v
C44	012-276	Capacitor, 10 uf/25v
C45	012-113	Capacitor, 350 uf/15v
C101	012-999	FACTORY SELECTED VALUE
C102	012-291	Capacitor, 1 uf/35v
C103	012-291	Capacitor, 10 uf/25v
C104	012-050	Capacitor, .01 uf
C105	012-267	Capacitor, .047 uf
C106	012-267	Capacitor, .047 uf
C107	012-267	Capacitor, .047 uf
C108	012-267	Capacitor, .047 uf
C109	012-068	Capacitor, 100 pf
C110	012-068	Capacitor, 100 of
C112	012-273	Capacitor, 2.2 uf/35v
C114	012-269	Capacitor, .1 uf
C116	012-304	Capacitor, 47 uf/20v
C117	012-011	Capacitor, 10 pf
C119	012-267	Capacitor, .047 uf
C120	012-267	Capacitor, .047 uf
C121	012-010	Capacitor, 3 pf
C123	012-068	Capacitor, 100 pf
C124	012-068	Capacitor, 100 pf
C126	012-033	Capacitor, 470 pf
C127	012-276	Capacitor, 10 uf/25v
C135	012-170	Capacitor, 82 pf
C136	012-033	Capacitor, 470 pf
C137	012-033	Capacitor, 470 pf
C138	012-150	Capacitor, 120 pf
C140	012-170	Capacitor, 82 pf
C214	012-260	Capacitor, 330 uf/6v
C401	012-260	Capacitor, 330 uf/6v
C402	012-269	Capacitor, .1 uf
C403	012-260	Capacitor, 330 uf/6v
C405	012-291	Capacitor, 1 uf/35v
C406	012-291	Capacitor, 1 uf/35v
C407	012-276	Capacitor, 10 uf/25v
C409	012-291	Capacitor, 1 uf/35v
C410	012-201	Capacitor, 1 uf/35v

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
C411	012-411	Capacitor, .01 uf
C412	012-110	Capacitor, 150 uf/35v
C414	012-291	Capacitor, 1 uf/35v
C415	012-269	Capacitor, .1 uf
C416	015-009	Capacitor, 8-60 pf Variable
C418	012-269	Capacitor, .1 uf
C419	012-269	Capacitor, .1 uf
C420	012-143	Capacitor, 220 pf
C421	012-273	Capacitor, 2.2 uf/35v
C422	012-273	Capacitor, 2.2 uf/35v
C423	012-260	Capacitor, 330 uf/6v
C424	012-276	Capacitor, 10 uf/25v
C425	012-067	Capacitor, .0047 uf
C427	012-260	Capacitor, 330 uf/6v
C428	015-009	Capacitor, 8-60 pf Variable
C429	012-260	Capacitor, 330 uf/6v
C430	012-268	Capacitor, .1 uf DISC
CR1	025-086	Diode, 1N4446
CR2	025-086	Diode, 1N4446
CR3	025-086	Diode, 1N4446
CR4	025-086	Diode, 1N4446
CR5	025-086	Diode, 1N4446
CR13	025-050	Diode, 1N752
CR14	025-044	Diode, 1N4006
CR15	025-086	Diode, 1N4446
CR16	025-086	Diode, 1N4446
CR17	025-086	Diode, 1N4446
CR21	025-086	Diode, 1N4446
CR22	025-086	Diode, 1N4446
CR24	025-086	Diode, 1N4446
CR25	025-086	Diode, 1N4446
CR27	025-086	Diode, 1N4446
CR28	025-086	Diode, 1N4446
CR102	025-086	Diode, 1N4446
CR103	025-086	Diode, 1N4446
CR104	025-086	Diode, 1N4446
CR105	025-086	Diode, 1N4446
CR106	025-086	Diode, 1N4446
CR107	025-003	Diode, 1N703A
CR108	025-086	Diode, 1N4446
CR109	025-086	Diode, 1N4446
CR110	025-086	Diode, 1N4446
CR111	025-086	Diode, 1N4446
CR401	025-086	Diode, 1N4446
CR402	025-086	Diode, 1N4446
CR403	025-086	Diode, 1N4446
CR404	025-086	Diode, 1N4446
CR405	025-086	Diode, 1N4446
CR406	025-003	Diode, 1N703A
IC1	076-002	Integrated Circuit, 741C
IC2	076-002	Integrated Circuit, 741C
IC3	076-002	Integrated Circuit, 741C
IC4	076-002	Integrated Circuit, 741C
IC10	076-002	Integrated Circuit, 741C
IC11	076-041	Integrated Circuit, 555

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
IC101	076-012	Integrated Circuit, 741K
IC102	076-012	Integrated Circuit, 741K
IC103	076-002	Integrated Circuit, 741C
IC104	076-002	Integrated Circuit, 741C
IC106	076-067	Integrated Circuit, CA3130
IC107	076-067	Integrated Circuit, CA3130
IC108	076-067	Integrated Circuit, CA3130
IC109	076-067	Integrated Circuit, CA3130
IC401	076-016	Integrated Circuit, 7490
IC402	076-036	Integrated Circuit, 4044P
IC403	076-010	Integrated Circuit, 733
IC404	076-010	Integrated Circuit, 733
IC405	076-012	Integrated Circuit, 741K
IC406	076-012	Integrated Circuit, 741K
J2	054-056	Socket, 15 pin
J3	054-056	Socket, 15 pin
J4	054-056	Socket, 15 pin
J5	054-056	Socket, 15 pin
L5	035-007	Inductor, 100 uh
L6	035-020	Inductor, 22 uh
L401	035-041	Inductor, 100 uh
L402	035-041	Inductor, 100 uh
L403	035-041	Inductor, 100 uh
L404	035-041	Inductor, 100 uh
L405	035-007	Inductor, 10 uh
L406	035-115	Inductor, 5 uh
L407	035-041	Inductor, 100 uh
L408	035-041	Inductor, 100 uh
Q2	062-010	Transistor, 2N3638
Q3	062-015	Transistor, 2N3568
Q4	062-132	Transistor, 2N2222
Q7	062-024	Transistor, 2N3644
Q8	062-024	Transistor, 2N3644
Q9	062-015	Transistor, 2N3568
Q10	062-024	Transistor, 2N3644
Q15	062-005	Transistor, 2N3053
Q16	062-048	Transistor, 40362
Q107	062-003	Transistor, 2N3567
Q108	062-024	Transistor, 2N3644
Q401	062-002	Transistor, 2N3565
Q402	062-002	Transistor, 2N3565
Q403	062-041	Transistor, 2N2905
R1	045-710	Resistor, 1K, 1/4w, 10%
R2	045-710	Resistor, 1K, 1/4w, 10%
R3	045-700	Resistor, 560 ohm, 1/4w, 10%
R4	045-724	Resistor, 2.2K, 1/4w, 10%
R5	048-196	Resistor, 2.5K Variable
R6	045-752	Resistor, 10K, 1/4w, 10%
R7	047-445	Resistor, 3.92K, 1/4w, 1%
R8	047-442	Resistor, 18.2K, 1/4w, 1%
R9	047-447	Resistor, 150K, 1/4w, 1%
R10	047-479	Resistor, 1 ohm, 1/2w, 10%
R11	047-513	Resistor, 1.5K, 1/4w, 1%

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R12	047-462	Resistor, 1K, 1/4w, 1%
R13	047-462	Resistor, 1K, 1/4w, 1%
R14	045-731	Resistor, 3.3K, 1/4w, 10%
R15	047-075	Resistor, 3 ohm, 3w, 5%
R16	045-731	Resistor, 3.3K, 1/4w, 10%
R17	047-075	Resistor, 3 ohm, 3w, 5%
R40	045-700	Resistor, 560 ohm, 1/4w, 10%
R41	045-710	Resistor, 1K, 1/4w, 10%
R42	048-209	Resistor, 5K Variable
R43	045-738	Resistor, 4.7K, 1/4w, 10%
R44	045-717	Resistor, 1.5K, 1/4w, 10%
R45	045-724	Resistor, 22K, 1/4w, 10%
R46	045-696	Resistor, 470 ohm, 1/4w, 10%
R47	045-752	Resistor, 10K, 1/4w, 10%
R48	046-054	Resistor, 47 ohm, 1/2w, 10%
R49	045-752	Resistor, 10K, 1/4w, 10%
R50	045-738	Resistor, 4.7K, 1/4w, 10%
R70	047-513	Resistor, 1.5K, 1/4w, 1%
R71	047-462	Resistor, 1K, 1/4w, 1%
R72	047-462	Resistor, 1K, 1/4w, 1%
R73	045-731	Resistor, 3.3K, 1/4w, 10%
R74	045-731	Resistor, 3.3K, 1/4w, 10%
R75	046-318	Resistor, 6.8 ohm, 1w, 10%
R76	045-738	Resistor, 4.7K, 1/4w, 10%
R77	046-318	Resistor, 6.8 ohm, 1w, 10%
R78	046-012	Resistor, 4.7 ohm, 1/2w, 10%
R79	045-682	Resistor, 220 ohm, 1/4w, 10%
R80	047-442	Resistor, 18.2K, 1/4w, 1%
R101	048-197	Resistor, 50K Variable
R102	045-752	Resistor, 10K, 1/4w, 10%
R103	045-710	Resistor, 1K, 1/4w, 10%
R104	045-764	Resistor, 20K, 1/4w, 5%
R105	047-440	Resistor, 10K, 1/4w, 1%
R106	048-157	Resistor, 10K Variable
R107	045-749	Resistor, 8.2K, 1/4w, 10%
R108	045-763	Resistor, 18K, 1/4w, 10%
R110	047-462	Resistor, 1K, 1/4w, 1%
R111	045-752	Resistor, 10K, 1/4w, 10%
R113	045-738	Resistor, 4.7K, 1/4w, 10%
R114	048-208	Resistor, 1K Variable
R115	047-502	Resistor, 49.9K, 1/4w, 1%
R116	045-731	Resistor, 3.3K, 1/4w, 10%
R117	045-731	Resistor, 3.3K, 1/4w, 10%
R118	046-026	Resistor, 10 ohm, 1/2w, 10%
R119	047-479	Resistor, 1 ohm, 1/2w, 10%
R120	047-479	Resistor, 1 ohm, 1/2w, 10%
R121	046-026	Resistor, 10 ohm, 1/2w, 10%
R122	047-449	Resistor, 2K, 1/4w, 1%
R123	047-479	Resistor, 1 ohm, 1/2w, 10%
R125	045-710	Resistor, 1K, 1/4w, 10%
R126	048-239	Resistor, 20K Variable
R127	048-239	Resistor, 20K Variable
R128	047-565	Resistor, 3.01K, 2w, 1%
R129	048-208	Resistor, 1K Variable
R130	048-173	Resistor, 200 ohm Variable
R131	048-208	Resistor, 1K Variable
R132	048-239	Resistor, 20K Variable
R133	048-209	Resistor, 5K Variable

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R134	045-738	Resistor, 4.7K, 1/4w, 10%
R135	045-668	Resistor, 100 ohm, 1/4w, 10%
R137	048-157	Resistor, 10K Variable
R138	045-714	Resistor, 1.2K, 1/4w, 10%
R139	045-735	Resistor, 3.9K, 1/4w, 10%
R140	048-241	Resistor, 500K Variable
R141	045-728	Resistor, 2.7K, 1/4w, 10%
R142	045-710	Resistor, 1K, 1/4w, 10%
R143	048-197	Resistor, 50K Variable
R144	045-747	Resistor, 7.5K, 1/4w, 10%
R145	047-710	Resistor, 1K, 1/4w, 10%
R146	045-654	Resistor, 47 ohm, 1/4w, 10%
R147	047-444	Resistor, 33.2K, 1/4w, 1%
R148	047-513	Resistor, 1.5K, 1/4w, 1%
R149	047-022	Resistor, 150.5 ohm, 1/4w, 1%
R150	045-731	Resistor, 3.3K, 1/4w, 10%
R151	047-443	Resistor, 22.1K, 1/4w, 1%
R153	045-654	Resistor, 47 ohm, 1/4w, 10%
R154	045-738	Resistor, 4.7K, 1/4w, 10%
R155	045-738	Resistor, 4.7K, 1/4w, 10%
R156	047-075	Resistor, 3 ohm, 3w; 5%
R157	047-075	Resistor, 3 ohm, 3w, 5%
R158	047-530	Resistor, 25 ohm, 2w, 1%
R159	047-460	Resistor, 100K, 1/4w, 15
R170	048-209	Resistor, 5K Variable
R171	045-752	Resistor, 10K, 1/4w, 10%
R172	045-752	Resistor, 10K, 1/4w, 10%
R173	045-752	Resistor, 10K, 1/4w, 10%
R174	045-752	Resistor, 10K, 1/4w, 10%
R175	048-209	Resistor, 5K Variable
R176	048-236	Resistor, 500 ohm Variable
R205	048-281	Resistor, 10K Variable
R207	048-281	Resistor, 10K Variable
R208	047-435	Resistor, 5.62K, 1/4w, 1%
R211	048-281	Resistor, 10K Variable
R212	048-281	Resistor, 10K Variable
R213	048-281	Resistor, 10K Variable
R214	048-281	Resistor, 10K Variable
R225	045-601	Resistor, 2.7 ohm, 1/4w, 1%
R235	045-738	Resistor, 4.7K, 1/4w, 10%
R401	047-445	Resistor, 3.92K, 1/4w, 1%
R402	045-710	Resistor, 1K, 1/4w, 10%
R403	048-196	Resistor, 2.5K Variable
R404	047-462	Resistor, 1K, 1/4w, 1%
R405	045-710	Resistor, 1K, 1/4w, 10%
R406	045-724	Resistor, 2.2K, 1/4w, 10%
R407	045-689	Resistor, 330 ohm, 1/4w, 10%
R408	045-679	Resistor, 180 ohm, 1/4w, 10%
R409	045-710	Resistor, 1K, 1/4w, 10%
R410	045-710	Resistor, 1K, 1/4w, 10%
R411	045-707	Resistor, 820 ohm, 1/4w, 10%
R412	045-710	Resistor, 1K, 1/4w, 10%
R413	045-710	Resistor, 1K, 1/4w, 10%
R414	045-710	Resistor, 1K, 1/4w, 10%
R415	047-999	FACTORY SELECTED VALUE
R416	047-999	FACTORY SELECTED VALUE
R417	047-999	FACTORY SELECTED VALUE

CKT REF NO.	TEXSCAN P/N	DESCRIPTION
R418	047-999	FACTORY SELECTED VALUE
R419	047-999	FACTORY SELECTED VALUE
R420	047-999	FACTORY SELECTED VALUE
R421	047-999	FACTORY SELECTED VALUE
R422	047-999	FACTORY SELECTED VALUE
R423	047-999	FACTORY SELECTED VALUE
R424	047-999	FACTORY SELECTED VALUE
R426	045-798	Resistor, 120K, 1/4w, 10%
R428	045-780	Resistor, 47K, 1/4w, 10%
R432	047-447	Resistor, 150K, 1/4w, 1%
R433	045-857	Resistor, 3.3 MEG, 1/4w, 10%
R434	047-460	Resistor, 100K, 1/4w, 1%
R435	047-492	Resistor, 56.2K, 1/4w, 1%
R436	047-446	Resistor, 68.1K, 2w, 1%
R437	047-464	Resistor, 9.09K, 2w, 1%
R438	047-461	Resistor, 11.3K, 2w, 1%
R441	047-461	Resistor, 11.3K, 2w, 1%
R443	047-367	Resistor, 330 ohm, 2w, 1%
R444	048-236	Resistor, 500 ohm Variable
R445	045-731	Resistor, 3.3K, 1/4w, 1%
R446	045-731	Resistor, 3.3K, 1/4w, 1%
R448	045-759	Resistor, 15K, 1/4w, 10%
S202	057-213	Switch

WARRANTY

Texscan Corporation warrants that each part of this product (except vacuum tubes and batteries) will be free from defects in material and workmanship under normal use and service. Texscan Corporation's obligation under this warranty shall be limited to repairing or replacing, F.O.B. Indianapolis, Indiana, each part of the product (except vacuum tubes and batteries) which is defective, provided that the buyer gives Texscan written notice of such defect within a period of one year commencing with the delivery of the product by Texscan Corporation. The remedy set forth herein shall be the only remedy available to the buyer for breach of this warranty, and in no event shall Texscan Corporation be liable for incidental or consequential damages for such breach. This warranty shall not apply to any part of the product which, without fault of Texscan Corporation, has been subject to alteration, failure caused by a part not supplied by Texscan Corporation, accident, fire or other casualty, negligence or misuse, or to any part rather than as a result of defect.

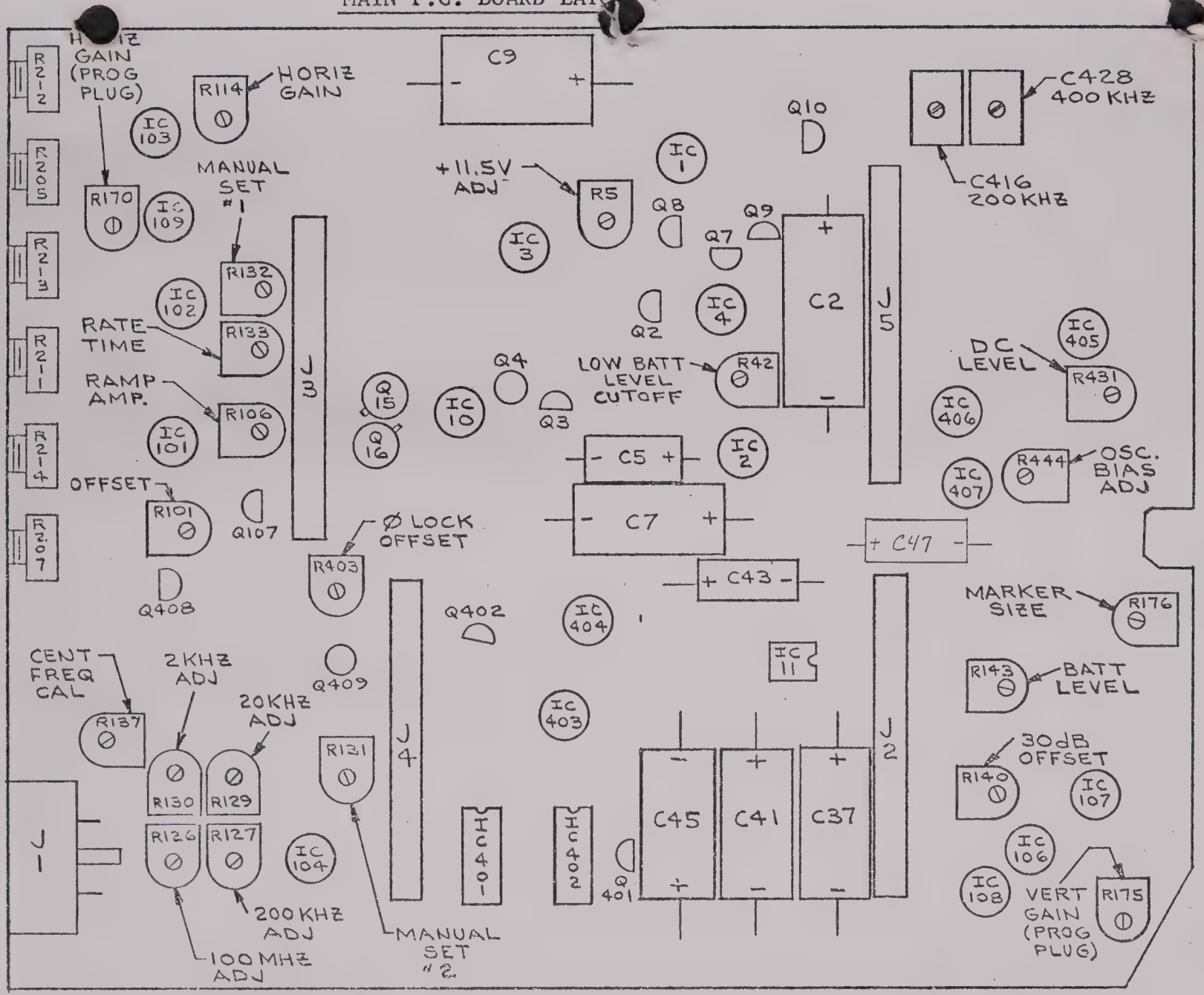
Except for warranties set forth above, and the warranties, if any, available to the buyer from the persons who supply Texscan Corporation any vacuum tubes or batteries contained in the product, there are no warranties, expressed or implied (including, without implied limitation, any implied warranties of merchantability or fitness), with respect to the condition of the product or their suitablilty for the use intended for them by the buyer or by the purchaser from the buyer.

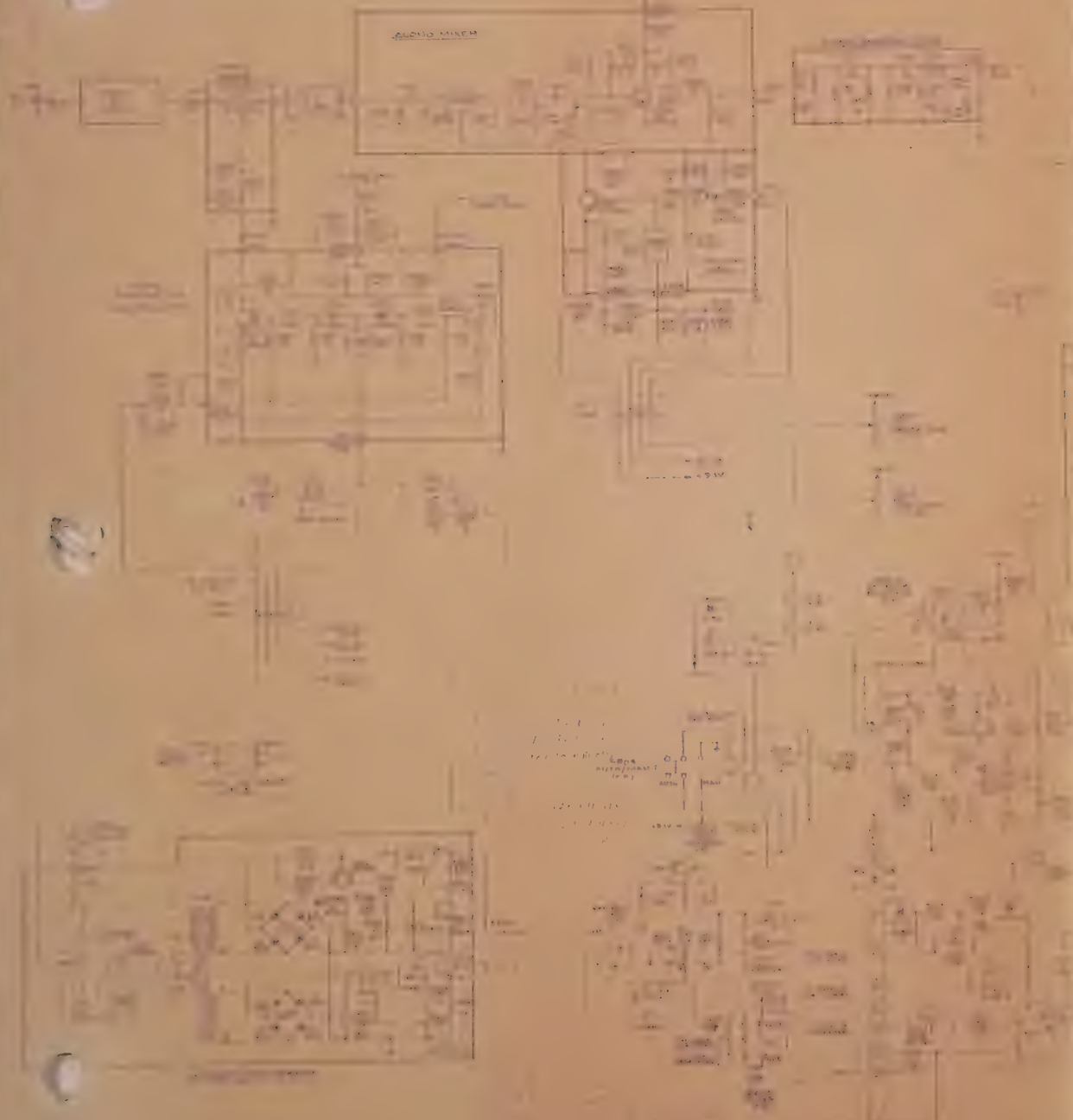
TEXSCAN CORPORATION

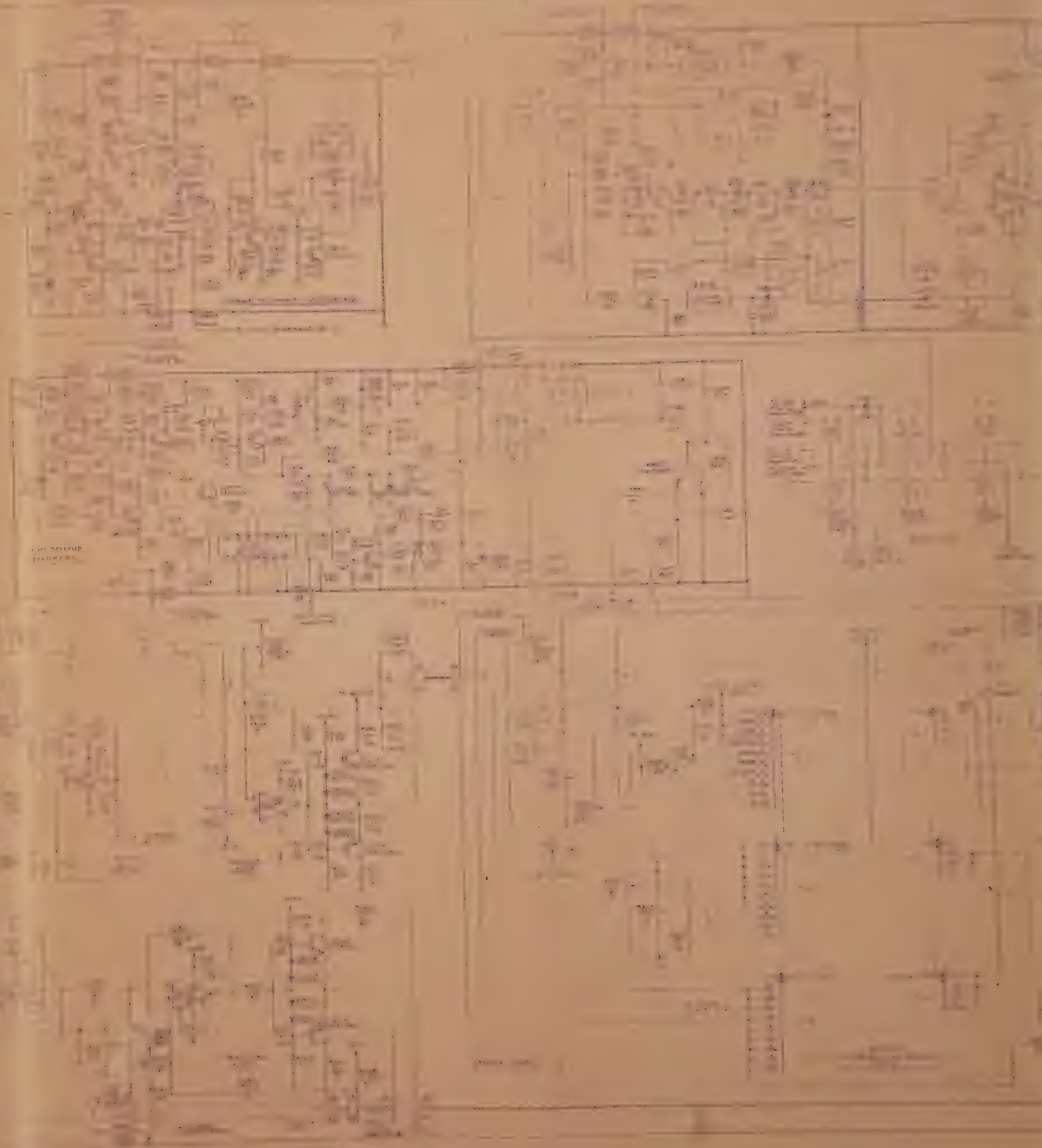
CUSTOMER SERVICE

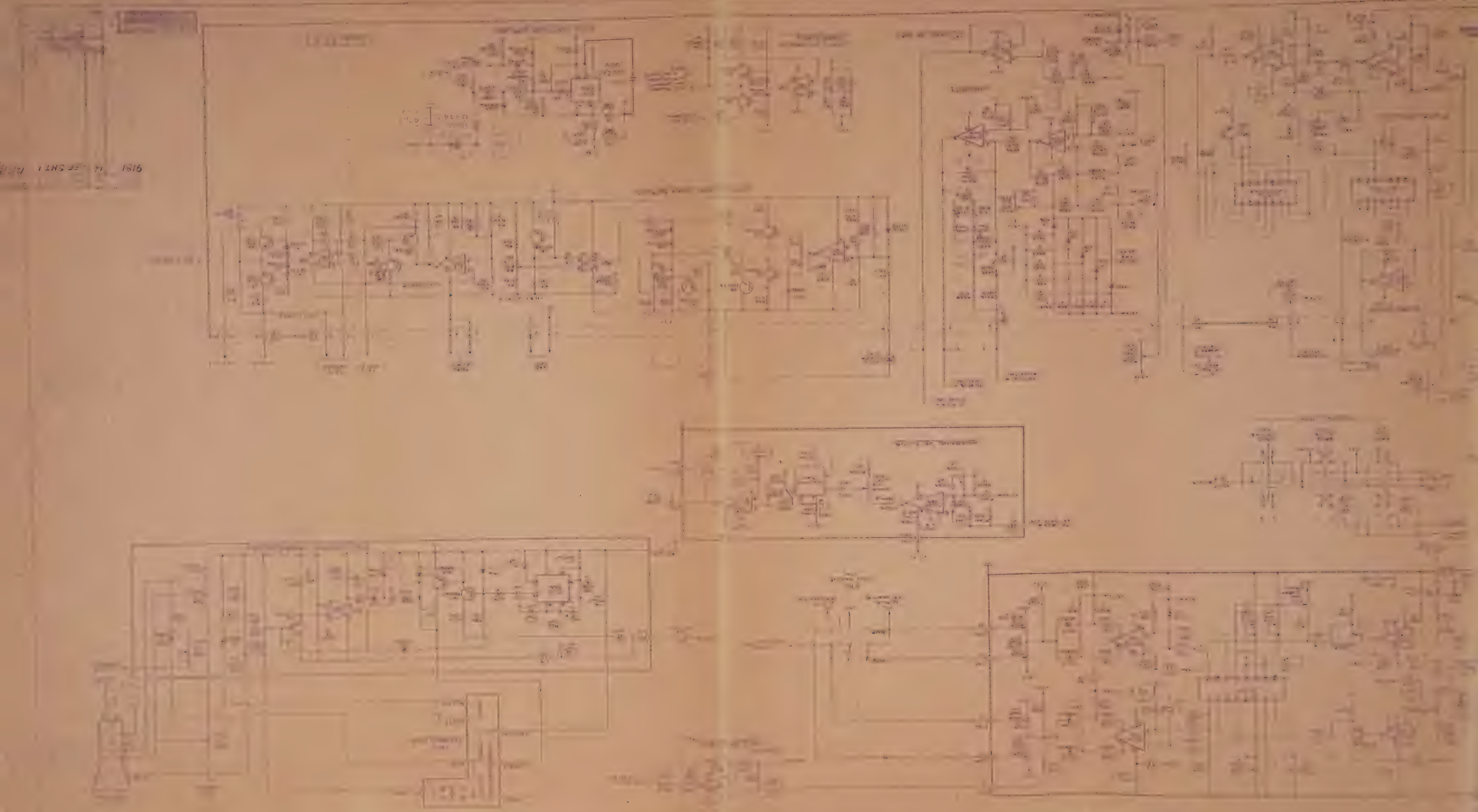
For prompt service, please call or write to Texscan's Customer Service Department for a Return Authorization Number. This will enable us to schedule your unit into the flow of work; units that arrive without the Return Authorization Number will not have the benefit of this prior scheduling.

MAIN P.C. BOARD LAYOUT




AUDIO MIXER





MP MASTER
MA33252